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INSTITUTE OF ECONOMICS  
INVESTIGATIONS IN INDUSTRY AND LABOR

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**WORKERS' HEALTH AND SAFETY:  
A STATISTICAL PROGRAM**



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# WORKERS' HEALTH AND SAFETY: A STATISTICAL PROGRAM

BY  
ROBERT MORSE WOODBURY

WITH THE AID OF THE COUNCIL AND STAFF  
OF THE INSTITUTE OF ECONOMICS

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## DIRECTOR'S PREFACE

This volume is the first in a series of monographs concerned with the improvement of economic and social statistics. The collection of statistical data, in whatever field, is to be justified only on utilitarian grounds. Statistics should be a means to an end, not an end in themselves, and that end is the improvement of economic and social conditions. It has, however, been the unfortunate experience of students of economic and social problems that much of the statistical material that is currently assembled is inadequate for the purposes of social control. This situation appears to be the result of two facts; first, a tendency on the part of statistical agencies to follow stereotyped patterns in the assembling of data; and, second, a failure to modify the scope and character of statistical programs to meet the needs of changing conditions or of shifts in emphasis in connection with current problems. On the one hand, our statistical compilations commonly include much material which no longer serves a useful purpose; while on the other hand, material bearing upon pressing current issues is all too frequently omitted.

In this study the Institute of Economics has attempted a constructive criticism of available resources in the field of accident and health statistics. We have not begun with a study of existing statistics merely with a view to pointing out improvements in methods of collection, tabulation, and presentation of data that might be effected. The approach has been to study, first, the present problems in the selected fields of health and safety with a view to ascertaining the objects and purposes for which statistical material is required. These

objects and purposes when analyzed are then used to point the way to detailed specifications for the data to be collected. With the specific needs in view the next step is to appraise the adequacy of existing statistics—to ascertain whether they meet the requirements, in what ways they fall short, where gaps are found, or where faulty methods unfit them for the purposes they should serve. The final step is to set forth a feasible program of statistics adequate for use in the control of current problems. This program includes two types of recommendations: First, the abandonment of superfluous compilations and the introduction of such changes in methods and tabulations as can be made without any major reorganization of existing methods and procedure, and, second recommendations for guiding the further development of statistics to meet present or future requirements.

HAROLD G. MOULTON,  
*Director.*

Institute of Economics,  
March, 1927.

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For the recommendations made and for any errors that may have crept into the discussion, the author assumes full responsibility.

He sincerely hopes that this book may be helpful to men of practical ideas in their efforts directed toward preventing accidents and wiping out disease.

ROBERT M. WOODBURY.

Washington, D. C.,

March, 1927.



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**WORKERS' HEALTH AND SAFETY:  
A STATISTICAL PROGRAM**



# WORKERS' HEALTH AND SAFETY: A STATISTICAL PROGRAM

## CHAPTER I

### THE IMPORTANCE OF STATISTICS OF INDUSTRIAL SAFETY AND HEALTH

This volume deals with problems of industrial health and safety with special reference to the uses of statistics in their control.

The need for statistical data with regard to any problem depends, in general, upon the importance of the problem, as well as upon the usefulness of data in its solution. The detailed requirements for statistics depend upon the nature and specific characteristics of the issues. Whether the purpose be to appraise the general need or to ascertain the detailed requirements for statistical data on health and safety, consideration should be given to two topics: the scope and importance of the problems of health and safety, and the value of statistics in dealing with them effectively.

The problems that form the subject of the present discussion comprise those that concern directly the safety and health of wage earners, and those created by the social and economic consequences of accidents and ill-health. They include not only questions relating to preventing accidents, to wiping out disease, and to eliminating the causes of ill-health, but also questions relating to relief of the economic and social conse-

quences of un prevented injuries and sickness, to lightening the burdens of wage losses and medical expenses, and to so distributing costs as to minimize economic burdens.

In order to make the present study more concrete and its recommendations more definite, the discussion will be limited to the United States and specifically to that part of the gainfully occupied population which is employed for wages or salaries.<sup>1</sup> This omits from consideration employers and other proprietors, the professional classes, farmers, and independent workers in general. The group of workers in the United States to which the discussion is thus restricted comprised in 1920, it may be estimated, about 30,000,000 persons.

In the case of wage and salary earners, the hardships due to losses caused by accidents and ill-health are particularly severe, and the prevention of injuries and the protection of their health offer, therefore, an especially important field for social activity. From the social point of view accidents are important, of course, whether they occur to employees or to employers, to farm laborers or to farmers, to wage earners or to persons engaged in professional occupations. Accidents to all classes should be prevented, and in all cases such provisions should be made as to reduce the burden upon society to a minimum. Likewise ill-health on the part of employers and directors of industry, of farmers, and of professional men should be prevented. Nevertheless, lightening the burden of losses is most urgent in cases affecting the wage and salary earning classes, not only because the latter are more frequently near the border line between comfortable self-support and extreme poverty and dependency, but also because they are least able to pro-

<sup>1</sup>The term wages is technically applied to payment for labor performed under an informal contract that is usually terminable without notice or on very short notice, while the term salary usually implies a more or less formal contract, with payment by the month or year, which can be terminated only by formal notice. In the present discussion the term wages will be used to cover both wages and salaries, since for present purposes the distinction is not important.

tect themselves. They are not in a position to introduce the means by which occupational accidents or ill-health can be prevented, or to exercise control over the business policies which may affect the occurrence of accidents or the prevalence of occupational disease. Moreover, the application of measures for preventing accidents and ill-health among wage and salary earners will, in general, furnish a solution of the problems of prevention as they affect other classes.

The importance of the problems connected with the safety and health of the wage earner is further indicated by the scope of the interests affected. These problems concern not only workers and their dependents, but also industry and society.

*Every wage earner is personally concerned with health and safety.* An injury causes pain and suffering. A serious accident may involve loss of eye-sight, of limbs, even of life. No mere money compensation or other measure of alleviation can make up for loss of life or complete physical disability. Even though in a particular year a wage earner is not himself a victim of any accident or disease, the fact that he is exposed to these risks brings him to regard measures of prevention as his immediate concern.

Injury and ill-health also bring the worker losses of income and earning power. The worker directly affected by accident or ill-health is faced with the problem of making ends meet, of providing food, clothing, and shelter for himself and his family when the sole, or principal, source of the family income, his earnings, has failed. In these circumstances the wage earner is vitally concerned with measures for alleviating the consequences of these misfortunes—with compensation for injuries and with provision for sickness benefits.

The dependents of workers are likewise personally affected by the misfortunes which touch their bread-winners. Measures providing compensation, benefits, and annuities to take the place of the income interrupted or cut off are of direct concern

to them. They are likewise benefited by measures for preventing accidents and sickness since these measures lessen the chance of their ever being numbered among the dependents of persons affected by these misfortunes.

*Industry is interested in preventing these contingencies.* Accidents and sickness interrupt the routine of work; they promote inefficiency; they cause absences of workers; they increase labor turnover; they cause expense in training new men to take the places of those killed and injured and of those who die or are incapacitated by disease or sickness. Wiping out these causes of lost time would add greatly to the efficiency of industry. The close relation which exists between health and efficiency has stimulated many establishments to create industrial clinics to promote and improve the health of their employees. Furthermore, the elimination of accidents and sickness tends to favor efficiency by fostering a better spirit of co-operation among employees who realize that their employers are taking an active interest in their safety and health.

The fact that under existing workmen's compensation laws a considerable proportion of the costs of compensation for injuries is placed upon industry adds to industry's immediate pecuniary advantage in preventing accidents. The interest of industry in preventing accidents and in minimizing their costs is given a concrete expression, indeed, in these charges.

*Society is interested not only in the effects of losses and misfortunes upon the workers directly concerned, but also in the ramifying consequences of these effects.* Society must, of course, concern itself with such direct menaces to the well-being of its members as occupational accidents and sickness. But indirect consequences must also be considered; for example, the effect of loss of the bread-winner's income upon the health and social status of the family and upon the educational advantages received by the children; or the effect of the premature death of the bread-winner upon the functioning of the family as an economic and social unit. What are the

specific effects caused by these misfortunes measured in terms of applications for poor relief and charity, of mothers' employment, of placing-out fatherless children, and of early child labor?

*Furthermore, society is concerned with the industrial efficiency of its labor force.* Enforced withdrawal of laborers from productive activity, whether because of preventable injuries or disease, represents a net loss. Society bears ultimately the costs of rearing and training its workers. Hence, maintenance of industrial efficiency and prolongation of length of useful service tend to decrease the costs in proportion to the results obtained. Full utilization of labor force increases the total social product to be divided. Elimination of waste and fostering of efficiency tend to redound, therefore, to the advantage of society as a whole.

The extent of losses due to accidents and ill-health can be shown by estimates of the numbers of persons who are each year directly affected. Their magnitude may be illustrated further by estimates of the amount of working time lost and of the monetary equivalents for wage and other losses. From the viewpoint of the wage earners the economic burdens caused by accidents and ill-health may be indicated by the wage losses and extra expenses entailed for medical service and for re-training. The loss to industry includes the costs involved in interruptions to the routine of work and such items as the cost of training new workers to take the places of those disabled or killed by accident or incapacitated by disease. The loss to society as a whole may be expressed in roughly approximate terms by estimates of the value of productive power withheld from other use because of these ills, including not only the loss of time on the part of those injured or disabled, but also the loss of time spent by physicians, nurses, attorneys, compensation agents, and others in repairing the damages which should never have occurred. Though such estimates disregard entirely pain costs and ignore many types of losses, they

alone suffice to show that the losses are of significant proportions.

It is obvious that any attempt to state the extent and magnitude of these problems in quantitative terms requires the availability of the very statistics the importance of which is under discussion. Nevertheless, though existing data are in many respects imperfect, as will be shown later, they perhaps suffice as a basis for rough guesses for illustrative purposes.

The number of workers directly concerned in occupational accidents each year was recently estimated by Commissioner Charles H. Verrill of the United States Employees' Compensation Commission as not less than 20,000 in fatal cases, 1,627 in accidents causing permanent total disability, 100,000 in accidents causing permanent partial disability, and 2,500,000 in those causing temporary disability of one day or more.<sup>2</sup> The exact number of accidents, of course, varies from year to year and is probably declining as safety and prevention work is extended. Whether the number of fatal accidents is 15,000<sup>3</sup> or 20,000, 23,000<sup>4</sup> or 25,000,<sup>5</sup> is not of material importance from the point of view of the present inquiry; any one of these figures suffices to show the importance of occupational accidents as affecting wage earners. The differences between estimates merely emphasize the need for accurate and comprehensive data.

*The total working time lost annually on account of occupational accidents may be estimated at 247,000,000 working days.* These are divided as shown in the table on opposite page.

<sup>2</sup>Verrill, Charles H., quoted in *American Labor Legislation Review*, Vol. XII, p. 13.

<sup>3</sup>Michelbacher, G. F., and Nial, Thomas M., *Workmen's Compensation Insurance, Including Employers' Liability Insurance*, p. 18.

<sup>4</sup>Williams, Sidney J., "Industrial Accidents," in *Waste in Industry*, by the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies, p. 331.

<sup>5</sup>Downey, E. H., *Workmen's Compensation*, p. 1.

## Estimated Number of Working Days Lost Annually on Account of Industrial Accidents in the United States.\*

Result of Injury	Estimated Number of Injuries	Estimated Working Days Lost
Fatal .....	20,000	120,000,000
Permanent total disability .....	1,600	9,600,000
Permanent partial disability .....	100,000	79,536,000
Other non-fatal .....	2,500,000	37,710,000
Total .....		246,846,000

\* Based on estimates made by Charles H. Verrill, quoted in text. This estimate involves assumptions, first, as to the number and average duration of accidents involving loss of time, and, secondly, as to equivalent time lost in cases involving death or permanent disability. The first assumption is based on the actual proportionate distribution of reported accidents; the second on the standards worked out by the Committee on Statistics of the International Association of Industrial Accident Boards and Commissions. (See below, p. 57.)

A somewhat more liberal estimate made by Sidney J. Williams on the basis of Dr. F. S. Crum's figures for accidents reached the figure of 296,000,000 days lost. This estimate was based on the assumption that there occurred each year 23,000 deaths, 115,000 accidents causing permanent total or partial disability, and a total of about 3,000,000 accidents causing disability lasting one day or more. See Williams, Sidney J., "Industrial Accidents," in *Waste in Industry*, by the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies, p. 331.

The magnitude of the economic losses may be more forcefully presented in monetary terms. This can be done only by estimating an average daily or yearly wage and by assuming further that employment would have been continuous and uninterrupted if it had not been for the contingencies considered. Even though such estimates and assumptions must be subject to serious reservations, they yield a result which helps to visualize the magnitude of these losses.

The annual total wage loss from industrial accidents, assuming an average wage of \$4.00 a day or \$1,200 a year, may

be estimated at \$988,000,000.<sup>6</sup> To figure the net economic loss to society, certain deductions and certain additions should be made. In the first place, the cost of maintenance of persons killed in accidents is saved and should be counted as an offset against the total wage loss and, in the second place, to find the net economic loss sustained as a result of accidents occurring in any given year the future earnings of persons killed or disabled should be discounted to the time when the accident occurred. Such a discounted sum for each casualty represents the value, at the time of the accident, of the losses which it causes. On the other hand, the costs of medical services, of accident and compensation insurance overhead and administration, of expenses incident to labor turnover and replacement caused by accident, and of other similar items should be added. The deduction needed for cost of maintenance may be taken as \$288,000,000,<sup>7</sup> and that needed for discount of future earnings as \$183,000,000,<sup>8</sup> leaving approximately \$517,000,000. To this

<sup>6</sup>This calculation is, of course, very rough. The average number of days worked during a year is probably less than 300, if allowance is made for unemployment, seasonal industries, and sickness. On the other hand, \$4.00 a day may be low. To be accurate, furthermore, various refinements would have to be taken into account. For present purposes it seems scarcely worth while to attempt a more careful estimate, since the purpose is simply to show that the sum is sufficiently large to make the possibility of saving even a small portion of it justify the expenditure of considerable sums in prevention, including the statistical analysis requisite for effective work.

<sup>7</sup>Sidney J. Williams estimated the cost of maintenance of the 20,000 persons killed as 60 per cent of the wages they would have received for a period of 20 years of working life expectancy. *Waste in Industry*, p. 332. But since 60 per cent seems high for current maintenance and apparently no allowance is made for maintenance after earnings have ceased, in the present estimate the expected cost of maintenance for life is estimated at 60 per cent of the expected wages for the 20 years of working life.

<sup>8</sup>A deduction of one-third is made as a rough approximation to the necessary discount. Such a deduction is equivalent to slightly over 4 per cent. Four per cent discount corresponds to a deduction of 32 per

should be added some \$161,000,000 for medical expenses and overhead insurance cost.<sup>9</sup> Not even an approximate estimate can be made of losses due to labor turnover and other causes. Accidents cause, then, a net economic loss of something like \$675,000,000 a year.

The number of individual workers directly affected each year by ill-health, regardless of its cause, sufficient to cause disability and absence from work, can likewise be obtained only by estimate. In this case, recourse must be had to European data for a satisfactory basis. According to German statistics, there are 40 cases of sickness each year for each 100 persons exposed to risk.<sup>10</sup> If sickness is equally prevalent in this country, 12,000,000 cases must occur on the average each year among the 30,000,000 wage and salary workers of the United States.

No attempt can be made to estimate the number of individuals whose lives are shortened by diseases or unhealthful conditions connected with their occupations, partly because no clear definition of these occupational influences can be given. Furthermore, an estimate of the possible additions either to the average working life or to the average life-span that could be made by specific measures of controlling diseases and conditions which affect the workers' health would be of far greater significance. But for such an estimate also satisfactory data are wanting.

*The 30,000,000 industrial workers, it may be estimated, lose each year 210,000,000 working days, or the equivalent of 700,000 working years, through ill-health.* This estimate is based on the assumption that each worker loses on the average

cent, 5 per cent to 37.7 per cent deduction, and 6 per cent to 42.7 per cent deduction.

<sup>9</sup> Sidney J. Williams' estimate, *Waste in Industry*, p. 332; \$161,000,000 is the difference between \$853,000,000, the net wage loss, and \$1,014,000,000, or the net economic loss, as figured by Mr. Williams.

<sup>10</sup> Rubinow, I. M., *Social Insurance, With Special Reference to American Conditions*, p. 214.

eight days (or seven working days) a year from sickness.<sup>11</sup> No estimate is attempted for the loss of working time due to premature cutting off of working lives through disease.

Assuming wages to average \$4.00 a day, the total wage loss from sickness causing absence from work may be estimated at \$840,000,000 exclusive of losses due to premature cutting off by disease of the working lives of industrial workers. In addition to wage losses, the costs of medical services should be considered. At an average of one dollar a day<sup>12</sup> (a pre-war figure) for all medical, hospital, and nursing expenses, these costs would amount to \$245,000,000. With regard to the loss from premature death, it should be mentioned that from tuberculosis alone, a disease which affects mainly the working ages, this loss is estimated at 500 million dollars.<sup>13</sup> The total economic loss from sickness and premature death among wage earners, therefore, may be estimated as at least 1,500 million dollars annually.

The foregoing analysis demonstrates the importance of the problems created by accidents and sickness. Even these rough estimates, which are all that can be drawn from existing data, show that the magnitude of the losses involved is such as to justify the most vigorous efforts at amelioration. We turn, therefore, to the second branch of the inquiry, into the im-

<sup>11</sup> *Ibid.*, p. 214. See also, Warren, B. S., and Sydenstricker, Edgar, *Health Insurance: Its Relation to the Public Health*, Public Health Bulletin No. 76, March, 1916, p. 6.

See also Sappington, Clarence Olds, "A Five Years' Sickness and Accident Experience in the Edison Electric Illuminating Company of Boston," *Journal of Industrial Hygiene*, Vol. VI, 1924, pp. 81-101.

<sup>12</sup> One dollar a day was the basis used for estimating the costs of medical care in an estimate of the losses due to sickness in Memorial on Industrial Diseases: *American Labor Legislation Review*, January, 1911, Vol. I, p. 127.

<sup>13</sup> Dublin, Louis I., and Whitney, Jessamine, "On the Costs of Tuberculosis," *Quarterly Publications of the American Statistical Association*, December, 1920, Vol. XVII, p. 445.

portance and usefulness of statistics in dealing effectively with these problems.

The value of statistics in dealing with any problem depends, in general, upon their usefulness in connection with control. Two questions, therefore, concern us in this inquiry: the extent to which control of the problems of accidents and ill-health is possible, and the character and importance of the service which statistics can render in making control of these problems effective.

It should not be forgotten that the primary interest of society in these problems is from the point of view of control. If by suitable measures society can eliminate causes of accidents or ill-health or prevent their consequences, the discovery, introduction, and development of such measures become of immediate and practical importance to all concerned. If statistics on accidents and health are needed to serve the purposes of control, their importance is second only to the importance of the program of control.

The possibilities of control as applied to industrial accidents and ill-health include prevention, alleviation of consequences, and distribution of costs. In the first place, the occurrence of accidents or disease may be prevented. This method, wherever applicable, is at once the simplest and most effective, since it avoids or eliminates all the evil consequences that may follow. Prevention, therefore, is the first goal of social policy. In the second place, the burden of economic losses which falls upon the worker may be lightened by appropriate measures of relief in such a way as to avert its more serious consequences. Finally, the transfer of part of the losses from the worker to industry, and their distribution by means of insurance tend to minimize the burden by apportioning the costs over a large number of contributors. By placing upon the employer a direct incentive to take safety measures this distribution tends also to stimulate prevention. Each of these methods plays its part in the prevention and control of ac-

cidents and ill-health and their social and economic consequences.

*Large possibilities of preventing accidents and illness exist.* This is indicated by statistical evidence already available. It is estimated, for example, that from 50 per cent to 75 per cent of all industrial accidents, at least in the more backward industrial establishments, can be prevented.<sup>14</sup> The experience of industrial companies in introducing safety work indicates that reductions of three-fourths in the accident severity rates can be achieved in some cases within a relatively short period. Data comparing the safer with the less safe half of the steel industry show that the accident frequency rate in the former is only one-fourth that prevailing in the latter.<sup>15</sup> Physicians estimate that a considerable proportion of sickness could be eliminated through adequate health supervision combined with treatments indicated as necessary by physical examinations.<sup>16</sup>

*The losses that fall upon the worker and his family can obviously be alleviated by appropriate measures of relief.* Here the question is not of the possibility but of the advisability and desirability of granting relief, of how generous the relief should be, and of the means by which it should be provided. The social and economic consequences of these losses can in large measure be eliminated by measures that replace the lost income from earnings by income derived from compensation or from sickness benefits.

*The burden of losses, whether upon the worker or upon in-*

<sup>14</sup> Williams, Sidney J., *Waste in Industry*, p. 333. Michelbacher, G. P., and Nial, Thomas M., *Workmen's Compensation Insurance, Including Employers' Liability Insurance*, p. 11.

<sup>15</sup> Chaney, Lucian W., "Accident Experience of the Iron and Steel Industry," *Monthly Labor Review*, Vol. 19, pp. 1139-1140.

<sup>16</sup> Dr. Eugene Lyman Fisk estimates at \$1,520,000,000, over and above costs, the possible annual net savings from comprehensive health supervision and periodical examinations of the entire population. See Fisk, E. L., and Sharpe, C. T., "Health of Industrial Workers," in *Waste in Industry*, p. 355.

*d*ustry, can be lessened by insurance. The application of the insurance principle distributes the losses among all those exposed to risk and thus minimizes the burden of cost borne by each individual. Nevertheless, questions as to the measurement of insurance premiums, as to the form of insurance, and as to the distribution of burdens between worker and employer must be considered as part of the problem of making these burdens a minimum. Furthermore, the general question of minimizing burdens must be considered in connection with that of prevention, because the manner of imposing insurance and the weight of the costs are important factors in the incentives which industry has to prevent occupational accidents and health injuries.

*A*t every point of the program statistics are indispensable. Statistical data are required in the first place to awaken interest in these problems and to stimulate prevention. The magnitude of the need for relief and the possibilities of prevention can be set forth only through statistics. In the absence of information in regard to the existence or character of evils no steps will be taken to remedy them. Prevention and control wait upon knowledge of the facts. Statistics must be available to set forth those facts upon which an effective appeal for remedial action must be based.

Statistics furnish a factual basis for measures of prevention and control. They show where the evils to be remedied are and indicate the magnitude of each specific evil. In prevention work they are required to analyze causes and to determine points and methods of attack. In lightening the burdens that fall upon workers they are required to measure losses and to show the extent of each type of loss. In distributing losses they not only measure the total costs to be distributed, but also are needed to determine the degree of risk, the basis upon which costs should be apportioned.

For guiding legislative policies statistics are indispensable. Legislative remedies constitute a most important branch of

prevention work. A study of gaps and inadequacies in existing measures suggests ways to increase the effectiveness of control. Statistics relating to the extent and operation of existing measures point out the need for and suggest the form of appropriate remedial legislation.

Statistical analysis is required to guide administration. The weak points in the operation of measures already in existence can be shown adequately and effectively only by properly prepared statistics. Analysis of the working of the system is the only satisfactory means of determining how successfully it accomplishes its aims. The efficiency of administration should be tested by means of statistical data.

Statistics are invaluable in appraising the effectiveness of preventive measures. Not only should the methods of attack be well directed and aimed to remove causes, but the proof that they are well directed can be furnished only by adequate statistical data. Data on the results achieved by specific methods of prevention are helpful in judging their value. Statistics are needed to test the progress of prevention. Correct appraisal of the work of control and prevention as a whole requires a bookkeeping of accomplishments, of losses and gains, of failures and successes, in the form of a statistical record of results. Only as a result of the work of an adequate statistical service can the task of prevention and alleviation be judged intelligently and directed to its maximum accomplishment.

In short, statistics are indispensable not only to show the possibilities of prevention and control, but also to transform these possibilities into realities with a maximum result for the effort expended.

*The statistical data obtained should, of course, meet the requirements of all those who will use them.* Their compilation should be undertaken with a view to satisfying the particular needs of those who have to deal with particular problems. The administrator requires data to form the basis for his report of work. He needs data to show what he is accomplishing, what

the weak points in his system are, and how they may be remedied. The safety engineer needs information to guide him in eliminating causes of accidents. The legislator needs information concerning the principal defects in existing legislation on accident prevention and disease control. He needs concrete data that will help him to determine what additional legislation is necessary or desirable. Employers who are intent upon making their establishments safe for their employees need data on the practical methods of eliminating hazards in their own plants. Safety and accident prevention agencies need data for use in campaigns to arouse public interest in prevention. Inspection services should be kept informed of the value of their own work. All these various users should be satisfied with respect to every legitimate and profitable use to which they can apply statistical data relating to their problems.

This general principle, that statistics should be available for practical uses, must be interpreted in a broad way. It is by no means sufficient merely to keep a record of official administrative acts. On the contrary, data should be gathered that will throw light upon the need for changes in legislation, that will show gaps in existing laws, that will help to perfect existing administration and to supplement existing measures. Data should be at hand for those interested in improving legislation and administration and in bringing about progress in prevention and control. Statistics that look toward the improvement of remedies and the elimination of problems serve the highest practical use. It is necessary, in short, to keep in the forefront of the analysis, not the technical details of administration by which the data are collected or to which they relate, but rather the problems which are to be solved. The analysis of these problems should give the clues by which the importance of these statistics can be judged and their details and characteristics determined.

In developing the program of statistics required, the discussion can be divided appropriately according to the nature of

the problems. Accordingly, Part I is devoted to "Industrial Accidents," and Part II to "The Workers' Health." In each part the problems are analyzed first with reference to the points concerning which statistical data are needed. The detailed requirements for these data are then summarized, including technical considerations relating to their collection and tabulation. With this background of statistical needs the existing data are examined and appraised, and in a final chapter for each part a detailed program of recommendations is set forth which embodies the principal conclusions suggested by the analysis. After developing recommendations for statistics relating both to safety and to health, a concluding chapter embodies a plea for action to make possible the immediate realization of these programs.

**PART I**  
**INDUSTRIAL ACCIDENTS**



## CHAPTER II

### PROBLEMS OF INDUSTRIAL ACCIDENTS

To bring about reforms in any field there must be an appreciation of the need for remedial measures. To effect an appreciation of the urgency of such measures full knowledge of the problems must be available. The first step toward control is a realization that evils exist, that they are important, that they can be remedied, and that the need for action is urgent. Only when the scope of a problem as a whole, as well as in detail, is appreciated, will measures of prevention and alleviation be taken on a scale commensurate with its importance and be directed intelligently toward its control.

Not only a general understanding, but an accurate and detailed knowledge, of the prevalence and severity of accidents is prerequisite to effective action directed toward their prevention or toward alleviation of the burdens which they impose. Without information that specific hazards exist no steps are likely to be taken to eliminate them. The history of all safety movements shows the influence of knowledge of danger over the direction and scope of remedial action. The close relationship between the occurrence of an accident involving the loss of many lives and the enactment of legislation to prevent the recurrence of similar accidents testifies to the importance of knowledge of the hazard in suggesting the need for preventive measures. As examples may be cited legislation for inspection of mines which followed the Plymouth mine explosion in Pennsylvania, legislation in regard to asbestos curtains in theaters which followed the disaster in the Iroquois Theater in Chicago,

legislation in regard to installing sprinkler systems which followed the Triangle fire in New York, and legislation requiring every ocean going passenger vessel to be provided with life preservers and life boats or rafts for all passengers and members of the crew which followed the Titanic disaster. In each of these cases the publicity attending a disaster affecting many lives brought knowledge of the existence of hazard effectively to the attention of the public and thus led to the adoption of preventive measures.

On the other hand, lack of knowledge in regard to the number of occupational accidents affecting mainly individuals or small groups has been perhaps responsible for the relatively slow recognition in this country of the gravity of the problem created by their total numerical importance. This is equally true of the burdens which these accidents place upon the injured workers and their families. When these burdens are borne individually or in small groups and are reported either as individual or personal items in newspapers or not reported at all they are seldom brought to the attention of the public with the emphasis which their collective importance demands. Public knowledge of non-spectacular accidents and of their always non-spectacular economic burdens—knowledge which must precede public action—can be obtained only through comprehensive accumulation and publication of the facts. The comparatively slow development in this country of legislation for adequate workmen's compensation can be explained only as a result of relative lack of knowledge on the part of the public concerning the scope and extent of occupational accidents and their consequences. Even yet, in five states and the District of Columbia, injured workers and their families have no legal right to compensation except through the uncertain procedure of civil suits under closely limited employers' liability legislation. In contrast, the intimate knowledge of the burdens borne by injured workmen and their families gained by their fellow workmen through personal contact or

through appeals for aid to their unions, doubtless played an important part in the relatively early development of trade union benefits for accidental injuries, especially in industries, such as mining, which are subject to high accident risks. Knowledge of the extent and consequences of accidents is fundamental to adequate measures for prevention and relief.

The accurate and comprehensive knowledge required can be gained only through statistics. No one individual can form through personal observation any exact idea of the degree of hazard. On the one hand, personal observation is necessarily limited in scope and, on the other, the elements making for exactness are wanting. Only through statistics based upon reports of individual injuries is it possible to obtain an exact appreciation of the nature and extent of hazard. Although a catastrophic accident which appeals to popular imagination may inform the public in regard to the existence of a particular form of hazard, comprehensive knowledge of the existence of all types and degrees of hazard can be obtained only through comprehensive statistics.

As previously suggested, the detailed requirements of the data needed must be determined by an analysis of the nature of the problems presented by industrial accidents.

### I. NATURE OF THE PROBLEMS.

Industrial accidents and their consequences offer not one but a multitude of problems of great complexity. An engineer of a fast express runs past a signal light in a fog and his engine crashes into the rear of another train, splitting up two Pullman cars, derailing others, and killing or injuring a score of passengers and members of the crew. An explosion of coal dust propagated from corridor to corridor in a coal mine kills a hundred miners. A boiler explosion wrecks a manufacturing establishment and kills or injures all the workers in the building. In each of these cases problems of many types im-

mediately arise. One type of problem is connected with giving first aid to the injured and putting them in the way of recovery and restoration to health and personal efficiency. This may involve extensive rehabilitation and retraining. Another consists in providing means for defraying expenses of medical care and of the care and maintenance of dependents during the period of their bread-winners' incapacity. Frequently there is a problem of maintaining family standards of living where these are threatened in consequence of loss of income. Other problems have to do with repairing damage to equipment and restoring service, with fixing responsibility for accidents, with determining their causation, and with devising ways and means for prevention.

Each accident thus produces many types of problems. How to provide medical care and relief for the injured, how to restore lost earning power, how to prevent injuries are problems common to each accident. Others are peculiar to particular groups of accidents. When all the various forms of injury that occur in all occupations are considered, and when these are multiplied by the thousands and tens of thousands of such accidents that occur each year, one can begin to form an adequate conception of the scope, importance, and variety of the problems involved in industrial accidents.

This welter of problems of many types loses much of its apparent complexity when viewed from the standpoint of control. From this viewpoint chains of causes and effects are seen, which suggest possibilities at each link of breaking the sequence of causation. As indicated in the preceding chapter, there are three principal points of attack upon the whole series of evils and losses connected with industrial accidents. These points may be considered as determining the basic problems connected with accidents, which are: first, the problem of preventing accidents; secondly, that of alleviating the burdens of losses; and thirdly, that of distributing costs. The present chapter is devoted to a survey of these problems with a view to

furnishing a background against which the need for data to aid in their solution is later brought into relief. This review suggests the extent of the need for statistics, and gives hints as to the kinds of data required and the ways in which they would be of service.

## II. PREVENTION.

Of the three main problems involved in controlling industrial accidents that of prevention should be given first consideration. As contrasted with alleviating consequences and distributing losses, prevention of the accidents themselves is obviously to be preferred. The application of preventive measures comes at a point in the chain of causation which is precedent to the points where measures of alleviation and of distributing costs can be applied. Prevention, if successful, takes away the need for alleviating burdens and distributing costs. Other things being equal, therefore, efforts and expenditures directed toward prevention yield a larger return than efforts and expenditures directed merely toward alleviating the burden of losses.

The problems of prevention are questions of ways and means, and of methods and policies, by which accidents may be prevented. Where are preventive measures to be applied? By what means can accidents be prevented most effectively? By what tests is prevention to be judged? How are methods and policies to be appraised?

*Obviously, preventive measures are needed wherever danger exists.* The presence of danger is best indicated by the occurrence of accidents; the larger their numbers and the more serious they are, the greater is the degree of risk. But, though the occurrence of accidents indicates the presence of hazard, and though accident frequency and severity rates furnish probably the best single measure of its degree, the fact that no accidents have ever been recorded for a particular point of

danger does not necessarily prove that none will occur. The development of new points and types of hazard will not always be indicated by a record of past accidents. Hence, accident records, and risk rates based upon them, should be supplemented by data showing the number and importance of danger points. The full scope of the need for preventive measures may be shown by a survey of industrial hazards.

A few illustrations will show concretely the outstanding need for statistics on accident occurrence. Owing to the blindness of the worker to risks in his own occupation and to the superficial optimism with which, in the absence of adequate information, the public regards industrial hazards, such simple and elementary questions must be answered as the following: Do occupational accidents occur in the District of Columbia, which has no workers' compensation legislation? Are workers in agriculture exposed to danger to life and limb? To what risks are newsboys exposed? Do accidents occur in establishment X (which carries on no safety work of any kind)? Information as to the industry, occupation, establishment, and state in which accidents occur is germane to the practical problem of determining where preventive measures should be applied.

A further practical use for information on accidents is to direct preventive work into the most efficient and economical channels. While all accidents should be prevented, it is, nevertheless, true that in undertaking a campaign for prevention—in an establishment, for example—the most hazardous risks are the ones which require first attention. The greater the risks the more urgent prevention is, and the more may be accomplished by a single preventive measure.

Less important only than statistics regarding the facts of industrial accidents are data indicating their causes. Methods of prevention must necessarily be directed toward eliminating causes and contributory conditions. Removing the causes prevents the accidents. Changing the conditions that favor risk should reduce the degree of hazard. Methods of prevention are

likely to be effective in proportion as they are directed toward removing significant causes.

*The determination or recognition of causes and contributory conditions is, therefore, an essential step in prevention.* The cause is the clue to the means by which the accident might have been prevented. Accidents due, for example, to lack of safety guards on machinery point directly to the means of correcting this defect. Gas explosions in coal mines point to the need for inspection to determine the presence of gas, for a ban upon open lights, and for ventilation to remove or dilute gas. Explosions of coal dust propagated through mine corridors point to the need for methods, such as rock dusting, to reduce the risk of explosions and to restrict the areas affected. Railroad accidents due to defective locomotives or defective rails indicate the need for measures to discover promptly the existence of defects in locomotives and tracks. Accidents due to electricity indicate the need for thorough insulation, for so arranging the wiring that workers cannot expose themselves in their ordinary work to contact with electric currents, or for such automatic devices as will cut off the current whenever a worker is necessarily exposed to danger, as, for example, in repairing machinery. In all these illustrations the causes of accidents not only indicate the points where prevention should be applied and the defects or conditions to be removed but also suggest methods of prevention.

*The analysis of causes should be carried out in sufficient detail to be of greatest service in preventive work.* In general, the more specific the cause the more significant it is for use in prevention. Typical accidents in mines and quarries, in manufacturing, and in railroad operations, can be ascribed in many cases to "tangible hazards." Wherever a machine is involved, such as a circular saw, a planing machine, or a punch press, the accident can be related to it in the first instance, and in the second to the point of operation, to defects in guarding, or to faults in initial construction. Accidents due to falls of coal

at the face should be distinguished from those due to falls of roof, since the methods of prevention applicable to them are different. New methods of prevention may require changes in the detail of causes. In case of accidents due to train collisions, for example, prior to the development and introduction of automatic train control devices, the analysis of causes should include whether the engineer was suffering from over-fatigue or from disease that might have caused lapse of attention at the critical moment, whether correct orders were transmitted to him, or whether there was some failure in the system of train despatching. After automatic train control is in operation, the analysis should throw light upon defects or failure in the system or upon gaps in its application.

*This analysis of primary causes should be supplemented by a study of contributory causes and conditions.* These are in general of two types, the conditions of work and the conditions affecting the worker. As examples of the former may be cited adequacy of lighting and of ventilation, suitability of temperature and humidity, layout of work rooms, and hours of labor; while as examples of the latter must be considered sex, age, nativity, ability to speak English, health, and physical and mental condition. The lighting expert may discover that an improvement in lighting arrangements is followed by a marked reduction in accidents which, in the analysis of primary causes, were ascribed perhaps to machinery. An improvement in conditions of ventilation may be followed by a decrease in accidents because of the greater alertness of employees when their workrooms are better ventilated. A change in personnel in a particular occupation, from men to women employees, or vice versa, or the adoption of rules against the employment of children in dangerous work, or of rules providing for the transfer of men from relatively hazardous to relatively safe occupations as they approach a definite age may result in lowered accident rates. Health examinations may lead to a better adjustment of personnel to the type of work. In short, accident rates may

be reduced by proper measures directed to the improvement of work conditions or to better personnel management.

The problems of prevention include not only locating accidents and determining their causes, for which the uses of statistics are obvious, but also devising means and methods for the elimination of specific causes, determining policies, providing incentives, allocating responsibilities, and creating agencies to carry these policies into effect. A brief review of these aspects of prevention will suggest ways in which statistical data would be helpful and the kinds of statistics that would be of the greatest service.

Devising means and methods for the elimination of specific causes of accident is, in general, a matter for the safety expert or technician. In many cases, accidents due to a given cause may be eliminated in a number of ways. For example, injuries caused by an unguarded point of operation on a machine may be prevented by any style of guard that effectively shields the operator from the point of danger. Such guards may vary in cost and in effectiveness. The details of their design and their adaptation to the specific nature of the hazard must be left to the technician.

If the worker is exposed to flying particles, emery dust, splashing of molten metal, or to other similar hazards, the wearing of goggles and protective clothing may prove the most effective, as well as a relatively inexpensive, means of prevention.

Radical changes in design of machinery or in layout of the plant may be the most effective means of preventing accidents of certain types. For example, if a railroad track is placed too near a factory building for safe clearance, with the result that employees on passing freight cars are continually exposed to danger, the only effective remedy is to correct the initial error by moving the tracks away from the building. Faulty construction of the "converter" in a Bessemer steel plant may cause accidents which can be prevented only by redesigning

it. Such methods eliminate the sources of accidents once for all.

Education of the work force to an understanding of the need for care and for safe practices in work is a useful means of preventing many types of accidents due to carelessness. Posting of signs, warnings, and instructions in English and, where any considerable number of workers are foreign-born, in the languages of the workers, is a helpful measure. Safety committees, talks by trained safety experts, and the inculcation of regard for safety into foremen and supervisors of labor are methods that make for lowered accident rates.

The adoption of personnel policies designed to lessen risk may also, as already noted, exert an important influence for safety. Whenever certain types of workers, for example, women, children, or old persons, are shown to be subject to unusual risk rates, assigning them to less hazardous work or refusing to employ them may minimize the frequency of accidents.

Modification of work conditions will often lower the frequency of accidents. As suggested earlier, methods of improving lighting arrangements or ventilation or reduction in hours of labor may effect an improvement in the accident rate.

*The selection of methods of prevention involves questions both of relative effectiveness and of cost.* At every stage in any practical program of prevention questions arise as to the probable success and the probable cost of each proposed measure. The effectiveness of any given means of prevention is determined by the conditions which cause accidents on the one hand, and by the technical design of the means on the other. An increase in effectiveness, if causative conditions remain the same, can be brought about by technical improvement of the means or by better adaptation of the means to these conditions. The progress of prevention is thus dependent in part upon expert designing and selection of efficient methods. The cost of any given measure depends

likewise upon technical conditions that govern the cost of providing the particular means. And progress in the design of cheaper means is dependent upon the technical expert.

Correct data concerning relative effectiveness and cost, though difficult to secure, are essential to a rational policy of accident prevention. Only on the basis of evidence is it possible to determine the effectiveness of any given method and its cost, on which the decision as to its introduction must depend.

Choices between alternative methods should be made on the basis of evidence showing their relative value as compared with their relative cost. The various types of measures available to reduce accidents, as summarized in the preceding paragraphs, illustrate the wide variety of possible choices. But measures differ widely both in effectiveness and in cost. One means may involve considerable—perhaps almost prohibitive—cost, while a second, with a different approach, may involve relatively little outlay. If equally effective the cheaper method is, of course, to be preferred. But often the cheaper method is only a makeshift which accomplishes the purpose imperfectly or in part. Sometimes methods are supplementary. This is true commonly of wearing goggles; they protect the eyes against flying particles which other methods are not always successful in eliminating. Selection and choices of methods are involved in determining how an appropriation for safety shall be spent. For example, shall an establishment spend its appropriation for safety in educational work or in "engineering revision," a term which includes all those changes of machinery design and layout of plant which eliminate once for all the risk attaching to each particular point of danger? Or how much shall be spent in each direction? Decisions on these points should, of course, be taken in accordance with the principle that expenditures should secure maximum results.

Whether such means and methods of prevention as have been

worked out by technicians, or indeed whether any method, shall actually be required involves decisions on questions of policy. In what cases, if any, is prevention of sufficient importance to society to justify active steps to further it? If alternative methods vary in effectiveness as well as in cost, and one method, though less expensive, is less effective, which shall be required? How much should be expended for preventing accidents? From the point of view of society the issue may be formulated in more general terms. How shall prevention work be organized to produce the socially most desirable results? How shall it be motivated? To whom shall responsibility for prevention be allocated and through what agencies shall the work be carried on? A brief consideration must be given to these points in order to set forth the whole question of prevention policy in its broadest aspects.

From the point of view of society, the alternative to preventing accidents is accepting or alleviating their consequences. As already suggested, other things being equal, prevention is always preferable, since, if successful, preventive measures eliminate the consequences of accidents. These "other things," when analyzed, are simply questions of cost. If prevention can be accomplished only at prohibitive cost under existing methods, society must either do without the goods or services involved or refuse to require prevention and accept or alleviate the consequences of the accidents that follow.

*The final decision as to how far prevention shall be carried rests with society.* If, for example, accidents due to train collisions can be prevented by the compulsory introduction of automatic train control devices, society must decide through its appropriate agencies whether or not it considers the results worth the cost. If mass accidents due to coal-dust explosions can be prevented by rock-dusting, society must decide whether or no it wills to prevent them. If prevention requires legislative prohibitions or regulations by bodies having delegated administrative or legislative authority, society as a whole,

through its constituted representatives, must express its decision.

The decision to prevent may be taken by smaller groups than society as a whole, for example, by industry groups, by establishments, or by any other group which has the authority to carry its decisions into effect and the means wherewith to defray the costs. Aside from public bodies, perhaps the most important decisions are those taken by employers or employing companies, by groups of associated establishments, or by industries. The voluntary adoption of safety codes and standards for certain industries is an example of a decision to put prevention into effect taken on the initiative of groups of employers.

In general, these decisions, whether by society or by subsidiary groups, are expressed in legislation or in regulations. Types of legislation and regulation include: first, prohibition of specific hazards coupled with inspection to discover infractions and with penalties for violations; secondly, regulation of working conditions; and thirdly, assessment of the cost of workers' compensation upon industry.

*In prohibiting specific hazards society recognizes the safety of employees as paramount to all questions of cost involved in eliminating these hazards.* The types of hazards to which this method of prevention is commonly applied include those which cause mass accidents—fire hazards, elevator hazards, hazards connected with the operation of coal mines, railroad hazards, and shipping hazards. In general, the serious consequences of the catastrophic accidents that may be caused by certain hazards far outweigh any questions of cost. The principal problem in such cases is whether there is available any effective means of prevention. These prohibitions to be effective must be enforced by responsible agencies equipped with a sufficient force of inspectors, having adequate appropriations, and backed by power to prosecute and to impose penalties.

*In regulating conditions of work, as, for example, in setting*

*up minimum standards and formulating industrial codes, society, or the subsidiary group concerned, recognizes their importance to safety.* The progress of prevention requires not only that new means for preventing accidents be devised, but also that the means already known be applied more generally. Safety standards and regulations promote prevention by incorporating gains already won and by extending the scope of approved methods. Since their costs are standardized their adoption merely raises the plane of competition and eliminates throughout industry the possibility of profits that might result from disregard of conditions essential to safety. While insuring certain minimum standards for the safety of labor it provides that their cost shall be defrayed at the expense of society as a whole, or of the particular industry or group of employers.

*Safety codes and regulations, like laws prohibiting specific hazards, must be enforced by adequate inspection services.* The discovery of violations of such codes can be accomplished most effectively by inspections by trained officials. Their duties should include not only inspecting to discover hazards which have been proscribed, but also suggesting new methods of prevention, and recommending, when in the interest of safety, the further extension of the regulations.

*In assessing the cost of workers' compensation upon industry, society sets in operation a pecuniary incentive for eliminating accidents.* As compared with prohibition or with safety standards or codes, this plan may be less effective so far as specific types of accidents are concerned, since the cost of eliminating them may exceed the gains from prevention. On the other hand, it is much broader in scope, since it offers a definite incentive, determined by the cost of compensation for the injuries which result, to eliminate each and every accident.

The effectiveness of this pecuniary incentive depends in part upon the generosity with which, in formulating plans for alleviating the burdens upon workers, the amounts of compensa-

tion are measured. If the compensation required includes the full cost of medical care and attention, the full amount in wage losses sustained, and the full cost of rehabilitating those who suffer permanent impairment of earning capacity, it represents a much more effective incentive than if it is restricted to 50 or 60 per cent of the wage losses. The amount of the incentive depends also in part upon the inclusion of other items, for example, insurance "overhead" costs. When compensation insurance is handled by private companies the premium rates quoted include not only the net cost of compensation but also an additional charge, called "loading," for all overhead expenses.

The larger the amount of the incentive, other things being equal, the more profitable is it for the employer to prevent accidents. In any given case it pays to prevent accidents, provided the cost of prevention is less than the amount of compensation which would otherwise be required for the injuries that would probably occur.

In practice, knowledge of the value of the incentive in relation to the cost of prevention is essential to action. The employer who fails to realize that accidents cost him more than the measures required to prevent them will probably fail to introduce these measures. In the absence of realization that prevention offers definite possibilities for reducing costs, no effort is likely to be made to search for new and more appropriate methods. Information as to the relation between costs of prevention, on the one hand, and compensation costs, on the other, is of great practical value in stimulating action and in rendering effective the pecuniary incentive.

The effectiveness of this incentive depends, in the second place, upon the closeness with which it corresponds to the risk and upon the sensitiveness with which it responds to changes in risk. For it to have its maximum effectiveness the establishment which introduces preventive measures should be rewarded by lower costs of compensation in proportion as these

measures are effective in securing industrial safety. The more direct the relation between prevention and costs of compensation, the more compelling is the incentive.

The usual method by which costs of compensation are assessed upon employers is through insurance in which the amounts assessed are determined by the average costs of compensation in the industry. These costs, in turn, depend upon the risk of accident, the severity of accidents, and the amounts of compensation awarded for different types of injury. When industries are compared with industries, this method offers an incentive which varies closely with the risk. Reduction in risk is followed by reduction in premium rates, and hence prevention is stimulated through expected savings in these rates.

But when establishments are compared with establishments in the same industry, the incentive to prevention appears relatively indirect. Reductions can be obtained only through movements toward prevention which affect the entire industry. If insurance rates are determined by average conditions within the industry, there is no special incentive for any particular establishment to prevent its own accidents. Whether or not it takes any action toward preventing its own accidents, it will be rewarded by a decrease in the accident rate for the industry as a whole. On the other hand, even though it accomplishes marked results in prevention in its own plant, it will secure no benefits in reduced rates except as the average rates for all establishments in the industry may be lowered thereby.

The effectiveness of the pecuniary incentive to prevention can be increased greatly by adjusting rates to take account of the conditions of hazard within each establishment. Two methods are commonly employed—schedule rating and experience rating—to make premium rates correspond more closely with establishment hazards. Each of these represents an attempt to bring the premium cost closer to the actual cost of compensation for the accidents that occur. They are de-

signed to make a reduction in accidents within an establishment mean a reduction in the costs assessed to that establishment. Schedule rating aims to accomplish this end by subtracting from the rate if conditions are present which make for safety—such as safety guards at all danger points or safety committees to suggest and enforce safe methods of work—and by adding to the rate if conditions are present which make for hazard—such as unguarded elevators, unguarded machinery, lack of inspection for gas or lack of rock-dusting installations in coal mines, and similar conditions varying with the industry. This method has the advantage that it informs the employer definitely what he must do to obtain reduced rates. It directs energy toward certain definite proximate objects in order to accomplish the ultimate object of preventing accidents. Experience rating, on the other hand, aims to accomplish the desired end by modifying the premium rate in accordance with the actual accident experience in the establishment for a period (say five years) preceding the premium year.

Both schedule rating and experience rating, if they are to be applied most successfully to increase the effectiveness of the pecuniary incentive to prevention, require careful analysis of the evidence. Experience rating obviously cannot be applied at all without analysis of the experience of each establishment. But to determine whether, and in what ways, it is more or less effective than schedule rating, requires also a study of the effectiveness in practice of each method. Furthermore, schedule rating, to be effective, must be based upon statistics showing the importance of various hazards. Singling out certain hazards for penalties or rewards will tend to promote their elimination, and it is important, therefore, that the right ones be selected if the greatest results in prevention are to be produced.

Turning from the types of legislation and regulation that embody the policies of society in regard to the extent to which prevention shall be carried, the questions of allocating re-

sponsibility and of choosing agencies for carrying policies into effect should be considered.

*Responsibility for devising and introducing effective methods should be allocated in such manner as to promote prevention most effectively.* Such responsibility should be joint rather than exclusive. Each agent who is in a position to assist in prevention should be held responsible for making his contribution to the joint result. In so far as this contribution depends for its effectiveness upon knowledge in regard to conditions, methods of prevention, and possibilities of success, information should be available in such form that it will be of greatest service to those who carry the responsibility for results.

The three major parties to share this responsibility are the worker himself, who is responsible for his own conduct; the employer (including the industry, the establishment, or any of the employer's representatives), who is responsible for conditions of employment; and society as a whole, which bears a general responsibility over the welfare of all its members. The individual worker's responsibility is accompanied by a direct and powerful incentive to prevention in the pain and suffering which may result from injury, as well as in the wage losses and expenses which an accident may entail. The employer's responsibility, though accompanied by the pecuniary incentive already discussed, is usually delegated to and borne by managers and superintendents, and most immediately by the foreman in direct charge of the work. Managers and superintendents are responsible for initiating and carrying out accident prevention policies and programs. But foremen are in a key position to promote safety, since each directly supervises the work practices and procedures of his group of workers. Society bears the final responsibility for accident prevention, since it must make the final decision on the question: *How far is prevention to be carried?*

These responsibilities must be discharged, and the various incentives to prevention must be made effective, through ap-

propriate agencies. In addition to the obvious agencies through which the state operates—workmen's compensation commissions, industrial safety commissions, inspection services of one type or another—and to those through which the individual establishment operates—such as safety departments and establishment safety councils—certain other agencies deserve special mention as being in a sense the result of the apportionment by society of responsibilities and incentives. These are insurance companies, industrial associations, and industrial or national safety councils. The basic interest of each of these latter agencies arises from the incentives and responsibilities placed by society upon industry.

Insurance companies which write workers' compensation insurance occupy a strategic position for promoting prevention. It is to their direct interest to eliminate all accidents in the establishments of their policy holders. They aid in this object by furnishing information in regard to the best methods of prevention. But perhaps their chief assistance is rendered by their safety experts who inspect the specific risks in each establishment and, as a result, make concrete suggestions for eliminating hazards. Insurance companies have great possibilities of service in preventing accidents.

Associations of employers or establishments within a single industry are also in an excellent position to further prevention. The customary method of determining insurance premiums for each industry by average risks gives to these associations a direct incentive to reduce risks throughout the industry. Exchange of information on the best methods of preventing accidents among members of such associations, or among all establishments in the same industry, will promote prevention, because in general the methods which are successful in one establishment are equally applicable to others in the same industry.

Safety councils, of which the National Safety Council is the prototype, co-ordinate efforts to further the progress of prevention throughout industry. They combine the work of in-

dustrial engineers, of persons interested in promoting safety, and of safety experts in all lines. They make it possible to pool the information available in regard to the most successful preventive methods in all industries. They stimulate further research in prevention. They aid in collecting the basic data required to test the results already accomplished and the information necessary to further progress.

In this discussion of ways and means of prevention, of methods and policies, of incentives and responsibilities, and of agencies for carrying them into effect, it is evident that at every stage decisions must be based upon information—information on hazards, on causes, on results, on costs, on the success of methods and policies, and on the efficiency of agencies. In their results lie the final tests of methods, policies, and agencies.

*Adequate tests of methods, policies, and agencies for the prevention of accidents must be developed and applied.* Not only is information needed on the relative effectiveness of methods as a guide to their selection, but the success of preventive efforts of all kinds should be appraised. The relative value of alternative policies and agencies, as well as of alternative methods, should be determined by the results achieved. Tests should be applied also to costs. Is the cost of maintaining particular agencies justified by the results? Is their administration efficient? Do they cover the ground adequately? What is the verdict on the program of prevention when it is tested by changes in the degree of risk as shown in a statistical record of accident frequency and severity rates? Such tests, based necessarily upon statistical evidence, constitute the touchstone by which a program of prevention must be judged and by which its future development must be guided.

### III. ALLEVIATING THE BURDEN OF LOSS UPON THE WORKER

Turning from the subject of prevention to that of alleviating the consequences of unprevented accidents, the problem

of lightening the burden of loss upon the worker occupies by far the most important place. The physical and economic consequences of accidents include, it is true, in addition to the losses sustained by the worker, physical damage to equipment, property losses, and losses due to interruptions in the use of machinery and in the routine of production. These should by no means be ignored. They add to the incentive which industry has to prevent accidents. But they represent in practice simply an additional item in the cost of production, which is normally transferred to the consumer in the shape of higher prices. They are, in essence, wastes. But being covered into business expenses they have no further consequences which need concern us here.

*The physical and economic losses sustained by injured workers, on the other hand, have far-reaching social consequences, the importance of which varies with the type and amount of loss.* These losses include not only loss of life, loss of limb, physical disability and impairment, but also expenses of medical treatment, losses in earnings, and losses in earning power. The consequences to wage earners include also those resulting from changes in family status caused by accidents and those resulting from the effects of the economic losses they have to bear.

Of first importance are cases of death or permanent disability of the bread-winner of a family. In fatal cases the dependents are left with the problem of supporting themselves. In cases of permanent disability the dependents are burdened, in addition, with the care of the disabled worker. The seriousness of these consequences of accidents depends obviously, therefore, upon the number of dependents and the degree of their dependency—in other words, upon the extent of the family responsibilities borne by the victim of the accident. The effects of the economic losses are conditioned, in the absence of measures to alleviate them, by the economic reserves at the disposal of the family in the shape of insurance,

savings, home ownership, possibilities of aid from relatives, or other resources. The results may include employment of the mother, curtailment of the children's schooling, sending them to work to help support the family, or placing them in orphanages or in private family homes. The loss of the father in fatal cases may react unfavorably upon the social upbringing of the children; the broken family may lead not only to juvenile dependency but to juvenile delinquency.

If disability is of a temporary character only, the consequences are, in the main, simply results of the economic losses sustained by the families and consist of readjustments necessary to meet living expenses and extra charges during this period. The effects of these losses also are dependent in large measure upon the family's economic reserves in the shape of insurance, savings, and other resources. Though these losses are in each individual case less important than in cases of permanent disability, in their total mass they assume large proportions.

*The untoward social consequences of accidents can be averted in large part by appropriate measures to lighten the burden of economic losses sustained by the injured persons and their families.* Since these consequences and burdens are due primarily to the economic losses sustained, measures to replace wage losses by other forms of current income, and to defray medical expenses and expenses for new training, where necessary, or to provide medical care and rehabilitation training directly, constitute appropriate remedies. By such means the consequences of accidents can be to a large extent controlled.

In considering the problems of alleviation, important questions to be answered are: where is alleviation to be applied? what means and measures should be employed? how adequate should alleviation be? and how should it be administered?

*Measures of alleviation are needed wherever physical and economic losses due to accidents constitute a serious burden.* The points where alleviation should be applied are shown by

the incidence of physical and economic losses. All workers injured by accidents suffer losses of greater or less extent. The most serious losses are found where the injuries are most severe, the duration of incapacity greatest, and the expense for medical care largest. A worker who is completely disabled requires aid greater in amount and for a longer period than a worker who suffers simply a minor injury. The family of a worker who is killed or permanently disabled requires assistance to compensate for the losses in income sustained as a result of the accident.

Knowledge of how great these losses are and of where they occur is important in order that measures of alleviation may be made broad enough in scope and may be directed intelligently toward the points where they are needed. A survey of the compensation laws in the United States shows that in five states and the District of Columbia the only recourse for workers injured in accidents or for their surviving dependents is to a civil suit for damages under employers' liability legislation. In addition, compensation laws in other states frequently do not cover entire industries or occupations, such as agriculture, fisheries, and public service occupations. Complete data on the points where losses occur and on their importance should reveal the seriousness of such gaps in the application of remedial measures.

*The kind of alleviation offered should be appropriate to the type of loss sustained.* Physical injuries require medical, surgical, and nursing care, and appropriate provision for all the extra expenses thereby occasioned. Wage losses require provision in the form of weekly or monthly income (or its equivalent) to meet living expenses. Losses in earning capacity require, in addition to benefits for making up temporary wage losses, provision for rehabilitating the injured so that they may be able again to earn a living. In each case measures should be so chosen that they alleviate the particular losses as efficiently as possible.

*Alleviation should be adequate in amount to accomplish its purpose.* Medical care which is inadequate to avert serious preventable consequences fails of its most important purpose. Such care must be promptly administered by properly trained physicians. First aid treatment of the injured is necessary to prevent infection and to reduce the seriousness of injury. Competent attention must be given promptly to all types of injuries if their physical consequences are to be made as light as possible. Failure to give such care may cause the worker serious wage losses and leave him with impaired earning power—consequences which could have been avoided if more adequate and competent attention had been available. A cheese-paring policy in the provision of medical and surgical care is unwise economy.

In cases where rehabilitation training is necessary to restore earning capacity, provision that is inadequate to enable the injured worker to earn his livelihood in an occupation to which his abilities and capacities are adapted likewise fails of its purpose. Great difficulties are found, it is true, in administering such rehabilitation wisely, in selecting the occupation in which the worker is to be trained, and in judging his capacities and abilities. But the object is to restore the worker's earning power. And rehabilitation which falls short of this result fails to accomplish its purpose.

Payments to the injured or to their dependents to take the place of lost income should equal a reasonable proportion of the wages lost. The purpose of such payments is to enable the worker and his family to support themselves in economic independence, and to give to his children such advantages in the way of education and training as he would normally have been able to provide. In case the bread-winner is killed by accident, the costs of maintaining the family may be slightly less than before by reason of his absence, but in case he is permanently disabled these costs will be as great or greater than before. A weekly payment that is far too small to defray

the ordinary expenses of the household fails to obtain any result commensurate with its cost. The remaining burden may be so great as to reduce the family to a state of grinding poverty or economic dependence, to prevent which is one of the purposes of alleviatory measures.

The form of such payments should be such as to give the most satisfactory substitute for wage losses. Commonly this purpose will be fulfilled by weekly or monthly payments of benefits. In rare instances a lump sum equivalent in value to these payments will afford a means of securing a continuous income more adequate to the requirements of the family than the weekly payments. In case, for example, a surviving widow can establish herself in the business of renting rooms through the use of a lump sum for the purchase of a suitable house, or in case the worker, in the absence of special provision for rehabilitation, can fit himself to earn his livelihood by taking a special course of training, these advantages may justify the commutation of weekly or monthly payments into a lump sum.

*Agencies and methods of administration should be selected for their efficiency—accomplishment of the work at reasonable costs.* In practice the principal forms of alleviation are those provided for under workers' compensation laws. Such laws may be administered by the courts, by commissions, by labor bureaus, or by specially designated commissioners. They may be supplemented by special provisions for rehabilitation or for vocational training administered through special bureaus. But the selection of agencies should be such as best to promote the carrying out of the purposes of alleviation.

*In final analysis, society is responsible for decisions in regard to alleviation policies.* Whether or not any alleviation shall be given, whether it shall be niggardly or generous, whether measures shall be well or poorly administered are at the will of society. But if such decisions are to be made

rightly, adequate information on all pertinent issues must be available. Information must be at hand on the extent and character of the consequences of injuries, on the results of failure to alleviate them, on the need for alleviation of each type, and on the adequacy or inadequacy of measures proposed or in force. Furthermore, data are required not only upon the positive effects of such measures, but also upon possible negative or undesired results, and upon costs, if a proper balance of advantage and disadvantage is to lead to the most useful decision.

With regard to the amount of compensation for wage losses, for example, not only alleviation but also the costs of compensation and the indirect effects which may be produced upon the accident rate must be taken into consideration in reaching a decision. Considering simply the purposes of alleviation, compensation for wage losses might properly equal these losses, except that, in fatal cases, the cost of subsistence of the person killed should be subtracted. But considering the burden imposed upon industry through the assessment of costs, the more generous the benefits to the injured, the greater are these costs and the greater are the burdens which industry has, in first instance, to bear. Are these so heavy as to impair the competitive position of industries or establishments? What proportion of the wage bill do they equal? In what proportion of cases are these wage losses shifted to the consumer? Do they have any untoward effects upon industry? Furthermore, the effects of too generous a measure of compensation upon the accident frequency rates and upon the duration of the healing period must also be taken into account. Would the payment of compensation equal to wage losses result in increased accidents produced for the sake of drawing pay without working? Would the drawing of payments equal to wages during convalescence tend to prolong unduly the period of healing?

A final consideration, which is perhaps of paramount im-

portance, is the influence which the assessment of costs upon industry has over prevention. These costs constitute an incentive to prevent accidents since, if prevented, the costs diminish. The larger the costs assessed, the greater this incentive, and the greater the incentive the more accidents will be prevented.<sup>1</sup>

On the other hand, with regard to the adequacy of medical benefits and of rehabilitation, it is clear that adequate measures mean lessened wage losses. The worker who receives medical benefits in adequate amount will be restored to industry more promptly and with less permanent disablement than the worker whose care has been deficient in promptness, competence, or skill. The justification for rehabilitation training is that it restores the workers' earning power and thus shortens the duration of compensation for wage losses. These alleviative measures are thus, in a sense, paid for out of benefits which would otherwise be required.

*Not only is evidence required upon the basis of which society can reach reasonable decisions in regard to alleviation policies, but also data are needed to test the results of methods adopted, to determine whether they are satisfactory or whether they should be changed.* These tests should cover, first, the adequacy of alleviation (including the consequences of lack or inadequacy of alleviation), and secondly, the efficiency of administration.

Tests of the adequacy of alleviation include tests of the scope of measures adopted, and tests of the amounts and forms of compensation provided. Do any considerable number of those who need compensation fail, for one reason or another, to obtain it? The tests should reveal the shortcomings of these measures. Particularly if the amount is inadequate for any real alleviation of the burdens, the tests should be such as to indicate this inadequacy. They should

<sup>1</sup> The evidence required to judge the effectiveness of this incentive is discussed elsewhere; see pp. 72-74.

indicate, furthermore, the number and proportion of cases in which the form of alleviation provided is unsuitable.

Since administration counts for much in the adequacy of relief afforded, the question of the efficiency of administrative agencies is important. Which of the agencies administering workers' compensation gives the most efficient services? How much do they cost? What method of administration gets compensation most quickly to those who are entitled by law to receive it? Which system supervises most efficiently the decisions or claims for compensation and provides most efficiently for promptness and regularity of payments? These are a few of the questions upon which evidence should be available to test the efficiency of agencies administering measures of alleviation.

#### IV. DISTRIBUTING COSTS TO INDUSTRY THROUGH INSURANCE

Intimately connected with the problem of alleviation is that of how to distribute the costs in such a way as to impose minimum burdens and to obtain maximum results. How shall these costs be defrayed? Shall the necessary funds be raised by assessments upon industries? Shall they be raised by taxation? In practice these questions of policy have already been decided, in most jurisdictions, in favor of assessment of a larger or a smaller proportion of costs upon industry and there is little point, therefore, in considering other alternatives here. However, two further questions deserve brief consideration: how much cost shall be assessed upon industry and how shall this cost be distributed?

*How much cost shall be assessed upon industry?* This question is raised, in the first place, as an issue in selecting the type of law. Employers' liability laws place a greater burden of cost upon employers than does the unregulated common law; and workers' compensation laws impose a still larger burden. The latter assess upon the employer, with few exceptions,

the entire cost of compensation and medical benefits. However, in final analysis the quantity and quality of compensation and medical benefits provided for under workers' compensation laws, and the measure of damages awarded by juries under employers' liability laws, determine the amount of costs actually assessed on the industry. The question as to how large these costs should be must be considered, as previously noted, in connection with the need for alleviation and the effectiveness of the incentive to prevention, as well as in connection with the capacity of industry to bear them. The last mentioned point is the only one to be discussed here.

The capacity of industry to bear the costs assessed upon it depends in the first place upon their amounts. In order to judge the importance of these costs in relation to other items of expense, evidence is needed to show not only the totals but also their relation to the total wages bill and to the total costs of production. In the second place, the capacity of industry as a whole, of a particular industry, or of a particular establishment to bear these costs depends upon its competitive position, upon the size of the margin of profits, upon the elasticity of demand, and upon the elasticity of other items of cost. Finally, the capacity of industry to bear such costs depends upon how they are assessed—that is, upon whether or not they are distributed by applying the insurance principle.

*Assessment of costs through insurance on the principle of distributing risk over a period of time, as well as over many establishments, tends to make the burden upon industry a minimum.* The practical application of the insurance principle of distributing costs according to risk requires information both in regard to costs and in regard to the degree of risk. As already developed, this information must be available in sufficient detail to make possible a close adjustment of premium rates to risk, not only for industries but also for establishments, and not only for differences between places or types of work but also for different times. In one sense data upon costs alone

contain information in regard to risks; the higher the costs, the greater the risks. But for the purpose of making estimates outside the range of direct observation the data must be analyzed into their constituent elements. For example, for estimating the cost of proposed changes in a law, for estimating costs for an industry for which only accident data are at hand, for transforming experience risk rates into cost rates—these require unit costs based on averages for each type of accident.

Important questions of policy are raised in connection with insurance. Should insurance be compulsory upon all employers or should "self-insurance" be permitted? Should state competitive insurance be provided or should state monopolistic insurance be required? In deciding such questions the two principal parties whose interests must be considered are the injured worker, who is concerned with the security of his compensation, and the employer, who is concerned with the cost of his insurance as well as with the completeness of his protection—the transfer of his own personal liability to a financially sound insurance fund. The state also is interested as a third party since it bears the final responsibility for supervising insurance, for providing that the worker shall receive his due compensation, and for seeing that the requirement of compulsory insurance is not too burdensome and offers sufficient protection both to employers and to workers.

*All employers should as a rule be required to insure themselves against their liability to pay compensation.* This principle is necessary for the protection of beneficiaries who, in cases involving serious or disabling accidents, may be entitled to draw pensions and benefits for many years after the accident has occurred. Such beneficiaries need protection against financial irresponsibility on the part especially of small industrial establishments. It is further necessary in order to introduce the very principle of distributing costs. That insurance be taken out in advance is the essence of this principle. If no employer

took out insurance until after accidents had occurred there would obviously be no effective distribution of costs. The most satisfactory way to protect the interests of beneficiaries, as well as those of the insuring employers themselves, is to make insurance compulsory.

The sole exception justified in theory is the case of the single establishment or company that is large and financially strong enough to satisfy within itself the principle that risks should be distributed over a sufficiently large number of employees to equalize accident rates and costs. For such a company there is an advantage, from the point of view both of the company and of society, in permitting self-insurance, because under self-insurance the incentive to prevent accidents is directly measured by their cost. On the other hand, comparatively few companies are sufficiently large in number of employees or in diversity of risk to justify granting the privilege of self-insurance. In the first place, with respect to catastrophic accidents, a coal mining company, for example, although large and apparently financially in excellent position, may find itself embarrassed or even made bankrupt by liabilities growing out of a single explosion or holocaust that involves all the workers in the mine. Secondly, self-insurance may fail to afford protection to the beneficiaries entitled to receive compensation on account of changes in financial status of even large and well-managed companies. In practice, furthermore, the administrative duty of deciding upon applications for permission to "self-insure" offers great difficulties, since unwise decisions will result in loss to the group of beneficiaries of these establishments. If self-insurance is permitted, conservative principles for guiding such administrative decisions should be developed and applied.

*Insurance should be supervised by the state in respect to both rates and reserves.* The two parties concerned are the beneficiaries and the employers. The interest of beneficiaries is in the financial solvency of the insurance carrier; their interest

can be protected by supervision over the adequacy of rates and reserves, the latter implying, of course, sound management and investment policies. The interest of employers is in the fairness of rates as well as in the complete transfer of their financial liability to responsible insurance carriers. The transfer of financial liability is usually accomplished by the same law that provides for compulsory insurance: insurance carriers are not permitted to limit their liability in respect to the insurer, although they may re-insure with other companies and thus pass on part of their liabilities. Fairness of rates is commonly left to the action of competition, under which the individual employer chooses between insurance companies on the basis of rates and service.

An important question of policy is whether the state should enter the field of competition in order to give insurance at low rates to employers who are required by law to insure. Points to be considered are the relative rates charged by private companies and by state funds, the relative efficiency with which claims are paid, and the amount and character of the services rendered. Industry has a direct interest in paying the minimum amount, other things being equal, for insurance service. But in practice this service consists not only in protecting employers against financial liability for compensation payments but also in giving them aid in preventing accidents and in eliminating hazards. Though employers may not always fully appreciate such aid both types of service rendered must be taken into account in evaluating the relative merits of private and state insurance. From the point of view of the worker, whose interests are perhaps paramount, the relative promptness and security of payments, as well as the attention paid to preventing accidents, should also be considered in reaching a decision on this question.

One policy designed to insure fair rates as well as security of payments is monopolistic state insurance. If state insurance is adopted should it be on a competitive or on a monop-

olistic basis? The questions to be answered with respect to this issue are similar to those already raised with respect to the relative merits of state and private insurance. What are the relative costs of each type of insurance? Theoretically, the costs of doing business should be much lower for monopolistic state insurance, since no expense need be incurred for obtaining "business." All employers must come to the state fund. But other elements in this question should also be considered. What are the services which each type renders? Which accomplishes more in stimulating prevention work, in helping employers to solve their special problem of preventing accidents? How do beneficiaries fare under each type? Under which form are claims paid most promptly and with due regard to justice and the requirements of law?

*Decisions on these questions of policy should be based upon and tested by statistical evidence.* The tests which can be applied to help in deciding what types of insurance should be permitted have already been indicated. They include, in the first place, tests of adequacy of rates and reserves. These require an elaborate statistical foundation for calculating net premiums. Premium rates, in any case, are tested by experience, since inadequate rates lead to inadequate reserves and, if not rectified, to financial insolvency, and these mean that victims of accidents are deprived of compensation to which they are entitled. In the second place, they include tests of fairness in rates, tests in which the first element is the ratio of insurance overhead costs to compensation payments and the second element is the extent and quality of service rendered in preventing accidents. In the third place, the promptness of payment of amounts awarded and due and other points connected with placing the amounts justly due in the hands of the beneficiaries offer a basis for testing the relative value of these forms of insurance.

In summary, this review of the problem of industrial acci-

dents, their prevention and alleviation, and the distribution of their costs emphasizes the need for information in regard to the prevalence and incidence of these risks, to their costs, and to their consequences. Such information is basic to any sound program for social control. In addition, the tests on the basis of which methods and policies must be decided require statistical evidence compiled in such a way as to answer specific questions regarding the progress of prevention, the adequacy of alleviation, the efficiency of administration, the cost of insurance, and, in general, the success and weaknesses of these methods and policies.

## CHAPTER III

### STATISTICS NEEDED IN RELATION TO INDUSTRIAL ACCIDENTS

In the present chapter the statistics required for the several purposes already outlined are briefly elaborated. Emphasis is placed upon statistics that are immediately obtainable and of greatest value; while data difficult to obtain with significant accuracy, or so expensive as not to be feasible, or of relatively minor importance, are either touched upon lightly or omitted entirely. While a detailed comparison of the statistics outlined in the present chapter with the problems described in the preceding chapter may reveal many gaps for which no statistics are here suggested, these gaps should be regarded as due to recognition of the practical, technical, or fiscal difficulties that at present confront the statistician.

In discussing the statistics to be recommended, some attention must be devoted to technical questions relating to methods of collection and tabulation, for these are important in connection with the accuracy of results and the practicability of collection. In particular, the principal ways in which the data should be classified are discussed. In other words, the present chapter is designed to set forth briefly the reasonable requirements for statistics to throw light upon the problems described in the preceding chapter.

#### I. FOR PREVENTION

The requirements for statistics to aid prevention may be summarized under the four purposes: (1) to locate and meas-

ure hazard; (2) to determine causes and contributing conditions; (3) to aid in determining methods and policies; and (4) to test results.

#### I. TO LOCATE AND MEASURE HAZARD

The statistics needed to locate and measure hazard fall into two groups, one comprising data on injuries and degree of risk, and the second comprising data on types and prevalence of points of danger.

Data in the first group, which is by far the most important, include statistics of accidents and injuries, and frequency and severity risk rates. These are fundamental to the study of accident problems and to any program of control. The particular information needed and the classifications and tabulations into which the data should be compiled call, therefore, for careful consideration.

The data should include information for all accidents. Each accident or injury that occurs should be reported to a statistical office. The system of reporting should cover all industries, all occupations, all establishments, and all workers in every state and community, irrespective of type of work, of the number of persons employed, and of whether the employer is a private individual, a corporation, or a governmental body. Only with the aid of such a system can a comprehensive check be maintained on the existence of hazards.

Reports should include all the details requisite for the subsequent processes of tabulation and classification.

Severity of injury is one of the most important items of information to be secured in regard to each accident. It furnishes a basis for classification that not only can be applied to accidents and their consequences but can be extended to the causes by which they are produced and the methods by which they can be prevented. Severity is a necessary item in determining the degree of risk, for a hazard that causes

death or permanent disability is obviously more serious than one that causes merely an injury of minor character.

Accidents should be classified according to severity into fatal and non-fatal, the latter being sub-divided into those causing permanent total disability, permanent partial disability (involving major and minor dismemberments), and temporary disability. The group of cases involving temporary disability should be further sub-divided according to duration of absence from work.

The collection of data concerning the severity of accidents involves certain difficulties. At the time of the first accident report, which should be made within two or three days after occurrence, it is frequently impossible to determine the ultimate outcome of the injury. In order to secure satisfactory statistics, therefore, a final report is necessary for a statement of the ultimate result of the injury and the total duration of absence from work. Accidents, for example, which result in such serious injuries as to cause death at any time before the date of this final report should be classified in the statistics as fatal.<sup>1</sup> In practice, therefore, it is necessary to set some definite time limit for filing this final report, for example, one year. And if the statistics collected within different jurisdictions or by different agencies are to be comparable the same time limit must be agreed upon and adopted by these jurisdictions and agencies.<sup>2</sup>

<sup>1</sup>The purpose of the compilation must be kept in mind. If a rough weighting of accidents according to their severity is required, the error in accepting a preliminary instead of a final report is not serious. For accurate comparisons between industries or between establishments, data should be on a comparable basis. For careful study of the actual duration of healing periods, data must be based on reports made after the completion of such periods.

<sup>2</sup>Compare, for example, the rule of the Interstate Commerce Commission under which only accidents that cause death within 24 hours are classed as fatal with the rule of the Bureau of Mines under which all accidents that cause death within one year are classed as fatal.

For many purposes it is desirable to weight accidents in proportion to their severity. Chief among these purposes, perhaps, is the determination of relative hazard. The number of accidents alone is far from a satisfactory measure of risk, since in such a measure minor count equally with major injuries and by far the largest proportion are of relatively minor importance. To measure relative risk accurately attention must be paid to the severity of the injury.

Probably the most useful method of combining the number and severity of injuries is afforded by weighting injuries roughly in accordance with the time loss in working days.<sup>3</sup> In cases of temporary disability the actual loss in working days should be given in accident reports, but for deaths and for cases of permanent total and permanent partial disability more or less arbitrary estimates of the loss in working time must be used. According to the scheme adopted by the International Association of Industrial Accident Boards and Commissions the loss in working time in fatal cases is rated as equal to 6,000 days. Other time loss equivalents, as adopted by this Association, are given in the table on opposite page.

It should be noted, however, that the Interstate Commerce Commission makes a special tabulation of deaths that ensue subsequent to the 24 hour period.

<sup>3</sup> Other possible bases for weighing injuries which might be considered are the cost of compensation and the wage losses. The cost-of-compensation method has the disadvantage that the cost varies with the scope and generosity of payments as provided in the law. Since laws vary from state to state, as well as from time to time, this method is unserviceable for comparative purposes. The wage-loss method is similar to the time-loss method except that it introduces an additional factor in the shape of the rate of wages received by the injured employee. This basis would represent more adequately the wage losses caused by accidents, but changes in wage rates or differences in wage levels between different industries or different states would destroy comparability as to severity of accidents as distinct from seriousness of wage losses. While each of these bases might have a limited field of usefulness, neither serves the purpose of measuring the severity of injuries as well as does the time-loss method.

Scale of Time Losses for Weighing Industrial<sup>4</sup> Accident Disabilities so as to Show Severity of Accidents.\*

Nature of Injury	Degree of Disability in Per Cent of Permanent Total Disability	Days Lost
Death .....	100	6,000
Permanent total disability .....	100	6,000
Arm above elbow, dismemberment .....	75	4,500
Arm at or below elbow, dismemberment .....	60	3,600
Hand, dismemberment .....	50	3,000
Thumb, any permanent disability of .....	10	600
Any one finger, any permanent disability of .....	5	300
Two fingers, any permanent disability of .....	12½	750
Three fingers, any permanent disability of .....	20	1,200
Four fingers, any permanent disability of .....	30	1,800
Thumb and one finger, any permanent disability of .....	20	1,200
Thumb and two fingers, any permanent disability of .....	25	1,500
Thumb and three fingers, any permanent disability of .....	33½	2,000
Thumb and four fingers, any permanent disability of .....	40	2,400
Leg above knee, dismemberment .....	75	4,500
Leg at or below knee, dismemberment .....	50	3,000
Foot, dismemberment .....	40	2,400
Great toe, or any two or more toes, any permanent disability of .....	5	300
One toe, other than great toe, any permanent disability of .....	0	...
One eye, loss of sight .....	30	1,800
Both eyes, loss of sight .....	100	6,000
One ear, loss of hearing .....	10	600
Both ears, loss of hearing .....	50	3,000

\* *Standardization of Industrial Accident Statistics*, Reports of the Committee on Statistics and Compensation Insurance Cost of the International Association of Industrial Accident Boards and Commissions, 1915-1919, U. S. Bureau of Labor Statistics, Bulletin No. 276, p. 77.

Any such scale designed to compare the relative severity of accidents of different types should rest, in theory at least, upon a sound statistical basis.<sup>4</sup> For comparisons to be valid, more-

<sup>4</sup> As an example of the application of statistics, the average working life expectancy of workers killed by accidents can be determined by special studies.

over, a uniform scale must be agreed upon and adopted for calculating the time lost.

In addition to the number and severity of accidents, a third requirement for measuring degree of hazard is the amount of "exposure" to the risk of accident. The number of accidents obviously varies with the number of persons exposed to risk. If the number of accidents increases 10 per cent during a 10-year period, no definite conclusions as to a change in accident risk can be drawn without taking into account changes in numbers employed. Other things being equal, furthermore, the number of accidents is likely to be greater the more days' time establishments are in operation and the more hours they run; hence, not only must the number of employees be available but also the time during which they are exposed to risk. The amount of exposure should be stated in terms of the number of man-hours of employment.

With information available both as to the number of accidents and the number of man-hours of employment, accident frequency rates can be calculated by dividing the number of accidents by the amount of exposure. If, in addition, data on the severity of accidents are available, specific rates for each type of injury can be calculated, such as the "fatality rate," the "permanent disability rate," and the "blindness rate." But the most convenient form of summary comparison of hazard which includes in a single index or rate all types of severity is the so-called "severity rate," which is formed by dividing the estimated number of days' time lost, calculated as previously explained, by the number of man-hours of exposure to risk. Such a "severity" rate, expressed in terms usually of the number of days lost per 1,000 man-hours of exposure, is the most useful single measure of hazard.

The purposes of such a calculation of risk rates are to show the true degree of hazard, and hence to aid in appraising the urgency of prevention, and to determine the most important points at which to apply preventive measures. Furthermore,

these rates constitute the basic figures for testing both changes in risk and the success or failure of measures of control. Data on the frequency and severity of accidents in relation to man-hours of employment are thus fundamental to any effective control of the problem of occupational accidents.

Not only should these data be collected but they should be tabulated and arranged in such a way as adequately to fulfil their purposes. They should be classified and analyzed by industry, occupation, and process, and compiled by establishments. In addition, summaries by states should be available.

A classification by industry is essential because the character of hazards and the problems of prevention are largely determined by the nature of the industry. The hazards of coal mining are entirely different from those of railroading; they require different remedies. The manufacture of steel has different problems of accident prevention from those which characterize the manufacture of textiles. Data on the degree of risk and on the classes of hazards must necessarily be analyzed by industries if they are to have any significance. But analysis by industry is fundamental also in distributing costs through insurance and in determining practical programs of prevention work. Whether the program is one undertaken by the state through legislation prohibiting or regulating specific conditions or one undertaken by individual employers, the preventive measures adopted, if they are to be effective, must be directed to the actual hazards in particular industries.

The problems that arise in defining industries, combining them into groups, and assigning particular establishments to the appropriate industry and group offer great difficulties. Establishments should be assigned to industries according to the nature of the risks. The principle that should be followed is to group together establishments which have risks of substantially identical character. If, in addition, the degrees of risk are approximately equal, no injustice is done in requiring the same insurance premium rate. The same principle of

classifying together similar risks applies to the formation of industry groups. In practice, the application of this principle is difficult because the character of risks varies to a greater or less extent from establishment to establishment and as a result the allocation of particular establishments to one or another industry class requires more or less arbitrary decisions.<sup>5</sup> On the one hand, a classification which takes into account all differences in character of risk will tend to be too detailed for practical statistical use, while, on the other, combinations into industries, and particularly into industry groups, of significant size will tend to ignore actual (though minor) differences in risk. The consequence is that in any classification each industry or group of industries includes establishments with risks which vary more or less from the typical risks of the industry or group. The greater the amount of variation the less specific and, therefore, the less comparable will be the industry and group rates.

The uses of such a classification according to industries and industry groups include: first, placing establishments in industry groups for determining premium rates; and secondly, comparing accident rates in different industries and in the same industry in different localities or under different conditions. The first use requires relatively detailed classifications to take care of all the differences in risks and in conditions that require particular treatment. The second requires comparability. A standard nomenclature and industry grouping should be agreed upon and adopted that will best serve both purposes.<sup>6</sup>

<sup>5</sup> For example, should a machine shop with foundry attached be classed as a machine shop, as a foundry, or in a special group? Should the decision depend upon the relative size of the two parts of the establishment, as measured by value of product, by number of workers employed, or by payroll?

<sup>6</sup> For the classification of industries tentatively recommended by the Committee on Statistics of the International Association of Industrial Accidents Boards and Commissions, see *Standardization of Industrial Accident Statistics*, U. S. Bureau of Labor Statistics, Bulletin No. 276,

To render specific the information as to where accidents occur data on accidents and exposure should be classified also by occupations or processes. Such a classification is necessary to define the problem of risk with which each worker is faced. Within an industry, occupations vary greatly in degree of risk. Railroading, for example, embraces a large variety of kinds of work, such as the occupations of locomotive engineer, of track walker, and of repair man in the engine house. The manufacture of steel includes a number of widely different processes. In many cases so many different kinds of work are included that the name of the industry alone does not indicate either the kind or the degree of hazard to which the various employees are exposed. Hence, detail by occupations is needed. Such detail would indicate those occupations and processes which are subject to the greatest risk and would thus show the points where the need for prevention is greatest.

The difficulties to be faced in classifying occupations are even greater than those encountered in classifying industries. They arise partly from inexactness in the use of occupational terms but more fundamentally from variations in the nature of the occupations themselves in different industries or different plants. In the absence of uniformity in the character of occupations or of a standard occupational nomenclature, accident rates for all except the most standardized and well recognized trades are likely to be subject to large errors. Nevertheless, for establishments or groups of establishments in which a uniform nomenclature can be introduced, such rates should be compiled. The practical value of data on occupa-

pp. 26-32. See also for a compilation of classifications in use in different countries, *Methods of Statistics of Industrial Accidents*, a report prepared for the International Conference of Labour Statisticians (29 October to 2 November, 1923), International Labour Office, Studies and Reports, Series N (Statistics), pp. 31-32, 56-57. See also Appendix III, 4th Report on *Systems of Classification of Industries and Occupations*, International Labour Office, Studies and Reports, Series N, No. 1.

tional accident risks depends upon the essential comparability of the rates.<sup>7</sup>

Information should be available concerning the degree of risk in each establishment. This is required to show each employer his particular problems. Such data bring to the employer, who is the authority primarily responsible for taking action to prevent accidents and for making decisions in regard to specific measures, the definite and detailed information necessary to guide him in the work of prevention. Methods of adjusting insurance premiums to take account of conditions in each individual establishment furnish, as already noted, an important stimulus to prevention. The importance of publishing comparative accident frequency and severity rates for large establishments at least should not be overlooked, since a good accident record is not only a cause for pride but is also an asset and therefore another incentive to prevention.<sup>8</sup> But the use of this incentive depends upon the availability of data on accidents and exposure for individual establishments.

The reports of accidents upon which all the more general statistics are based are furnished, of course, by individual employers. In furnishing such information each establishment amasses a complete collection of data in regard to its own risks. This material should be so analyzed that it can be utilized by the establishment in applying measures of prevention to its own hazards. The analysis may be made by the establishment itself; or special studies to throw light upon establishment problems may be made by other agencies, as

<sup>7</sup> Much progress has been made in recent years toward standardizing occupational nomenclature for railroad labor, for government work, and in other industries. Job analysis and job specifications are means by which occupational designations can be standardized and made comparable.

<sup>8</sup> An illustration of such a use of data is to be found in the accident records for the principal railroad lines published by the Interstate Commerce Commission.

by an insurance company for experience<sup>4</sup> risk-rating purposes, or by a central agency representing either the government or an industrial association.

The data should be summarized also by states to show each state what its problems are. The political organization of this country places upon each state the responsibility for remedial measures, whether for alleviating the burden of loss from accidental injury, for creating inspection services, for regulating or prohibiting special types of hazard, or for the general control of these problems. A distribution of accidents by states is, therefore, important as an aid in determining what state action is necessary.

The collection of reports of injuries for purposes connected with the administration of workers' compensation by state agencies gives the basic material necessary for tabulations by states. Such data are needed, it should be kept in mind, for guiding state action, not only with respect to preventive work—education, inspection, regulation, prohibition—but also with respect to the problems and methods of alleviation and insurance. For use in prevention the data must be classified, of course, by industries.

The second group of data required to show the points where preventive measures are applicable consists of statistics relating to the numbers and prevalence of typical hazards or points of danger. As examples of such points of danger may be cited the grade-crossing, the unguarded elevator well, the unguarded machine, and similar specific hazards where the absence of protective devices or guards constitutes a menace to safety. Once these conditions are recognized as hazardous, statistics which show their prevalence demonstrate the need for measures adequate to remove them as sources of danger.

The scope of data relating to specific hazards should depend upon the important practical uses to which such data can be put. A survey of hazards is a sort of stock-taking of risks by industry, preparatory to their elimination. The items to be

covered by such a survey should be restricted, in general, to well-defined and recognized hazards for which practicable methods of elimination or modification are available.

The establishment is in position to make such inventories of hazards to be eliminated and to apply information obtained from them to immediate and practical uses. To the establishment, therefore, surveys of hazards are of great value. Furthermore, an insurance company or insurance rating bureau could utilize such data in regard to establishments applying for an insurance rating. In practice, however, insurance company surveys tend to be qualitative rather than quantitative in character. Such data would be useful also in evaluating schedule risk-rating methods and in determining the credits or debits to be assigned each safe or unsafe condition.

Furthermore, an industry-wide survey of unsafe conditions in all establishments would be of invaluable assistance to an industrial association or safety council in appraising the state of safety in the industry and in selecting the directions in which preventive work is most needed and can accomplish the greatest results. However, in such a wide survey especially, the definite points covered must usually be restricted to a relatively few well-defined hazardous conditions as to the existence of which fairly comparable data can be obtained.

Such surveys offer a point of departure for preventive work. When compared with earlier surveys of the same type they also afford a means of measuring the progress accomplished.

## 2. TO DETERMINE CAUSES AND CONTRIBUTORY CONDITIONS

Statistics of causes are obviously necessary if preventive measures are to be adapted to the elimination of conditions responsible for producing accident. Two types of causes and causative conditions should be considered: those that may be regarded as directly responsible for accidents, and those that contribute to their occurrence. The elimination of the former

would prevent accidents and the correction of the latter would lessen the probability of their occurrence. The first may be designated as causes and the second as contributory conditions or circumstances. The method of investigation is different in these two types of cases. The analysis by causes applies to the accidents themselves, and does not involve an analysis of the exposure,<sup>9</sup> whereas the analysis of such contributory conditions as sex, age, health, lighting, etc., requires a classification both of accidents and of exposure before any significant conclusions can be drawn. Hence, the conclusion seems justified that in practice these causes and contributory conditions have to be handled differently.

*The classification of accidents according to their causes offers a difficult problem.* The first requisite to any analysis of causes is a complete report of the circumstances and conditions which produced the accident. This full statement should be part of every accident report. With this information at hand the statistical office can classify accidents according to definite and uniform rules.

Each accident, however, may have many causes, some important and direct, some indirect, some remote, the elimination of any one of which might have prevented, or rendered less probable, its occurrence. For purposes of classification one of these causes should be selected for tabulation. Although in occasional instances the designation of the primary cause may be somewhat arbitrary, as a rule some one cause is obviously of primary importance. The method of assigning each accident to one cause has not only advantages of simplicity of treatment and greater clearness in interpretation, but also it gives a result that is more significant for purposes

<sup>9</sup> Though in studying the degree of risk attached to a tangible point of danger data on exposure might conceivably be accumulated, as the risk of being run over at a specific street crossing equals the number of accidents there divided by the number of persons who cross the street: this sort of analysis is far too detailed to be of practical importance.

of prevention. To seek out for each accident all the secondary causes might lead to the discovery of five or ten or more causes of greater or less significance. If all accidents were treated with this degree of thoroughness the mass of data resulting would be overwhelming; while if different accidents were treated with varying thoroughness the statistical result would be hopelessly confusing. For practical reasons, therefore, the policy of allocating each accident to a single primary cause offers the best chance of securing useful results. The analysis of secondary causes in some cases, of course, is also useful, but its value appears to be distinctly secondary to that of the primary cause analysis.

The analysis of causes should be made in accordance with the uses to which the tabulation is to be put. In general, the objective is to promote prevention. The statistics of causes should, therefore, be so oriented as to further this end. In other words, they should point to the most effective means of prevention.

These considerations point to two more or less obvious principles. In the first place, the selection of primary causes should be made on a uniform basis. If a certain type of accident is produced by a given cause every accident similarly produced should be allocated to that cause. In practice this requires that definite and fixed rules be drawn up and applied uniformly to the classification of causes.

In the second place, value in prevention should be the guiding principle upon which to select primary causes.<sup>10</sup> If two or

<sup>10</sup> A classification according to fault is not a satisfactory classification by cause. In the first place, fault is personal and hence is applicable only to past occurrences in which particular individuals were concerned. An inference that if a worker, a fellow-worker, the employer, or the employer's agent was responsible in the past, they will be responsible in the same proportion of future accidents may not be justified. In the second place, allocation of fault is difficult to determine and is more or less arbitrary. It means practically bringing in a verdict. Finally, the allocation of fault as such is not helpful in pre-

more causes are concerned in an accident that one should be selected as the chief cause the removal or absence of which would have rendered the accident impossible. In other words, the cause should point the way to prevention.

The application of this principle can be shown more concretely by citing a specific case. A workman walking down an aisle slipped on the floor and fell against an unguarded machine and his hand was crushed in its meshes. Here are two specific hazards, the unguarded machine and the slippery floor. Contributory conditions and secondary causes may have been present. The aisle may have been littered with tools or materials so that the workman was forced to use a slippery passage; he may have been in a hurry or his attention may have been distracted from his work by outside interests or anxieties; the passage may have been poorly lighted; the health of the workman may have been poor; or he may have been approaching an age when he would have to retire from active work.

In this example the complexity of the actual situations that arise and the difficulty of selecting for statistical purposes a single cause that will sum up the need for prevention and indicate the direction it should take are well illustrated. The lack of a safety guard on the machine was probably contrary to law; if not, it ought to have been. If a guard had been present the injury would not have occurred even if the worker had slipped. Furthermore, if a guard were in place, no injury of that type could ever occur from that or any similar condition of the floor or aisle or in consequence of the ill-health or mental condition of the worker. Hence, the injury is properly to be assigned to the lack of a safety guard on the machine. Such an allocation is appropriate because it indicates the best method of preventing similar accidents in the future.

venting future accidents but tends rather to spread the conviction that, as fault is the aberrant manifestation of the human will, accidents in future cannot be prevented short of abolishing human frailty.

A corollary to be drawn from this example is that statistics of secondary causes should be compiled whenever such causes are directly and immediately responsible for producing accidents. A littered or slippery floor or aisle may appear of secondary importance in a single accident though it may be a contributory factor in producing many injuries and much lost time. Such conditions are easily remediable; their continuance should never be permitted; but if they are to be remedied, attention must be drawn to the serious consequences of neglecting them.

Statistics of causes should always be classified by industries. Without designation of the particular industry the cause analysis is hardly specific enough to throw light upon its peculiar hazards. Thus, accidents due to "falls of objects" may be found, for example, in lumbering, coal mining, or iron and steel manufacturing. In the first case they may be due to falls of trees, in the second to falls of roof or of coal, and in the third to falls of hot metal or objects being carried by cranes. To lump these together is to destroy the significance of the information for preventive purposes.

For comparisons between different industries and localities the cause classification should be so arranged that it is on a comparable basis. This can be accomplished by establishing broad groups to include similar types of causes. Thus, all accidents due to machinery, to electricity, and to handling of materials can be assigned to their respective groups, which can be subdivided as required for use in prevention. To facilitate such comparisons a uniform system of cause classes, together with uniform rules for interpretation and application, should be agreed upon and adopted.<sup>11</sup>

Such a uniform system of classifying causes should be so

<sup>11</sup> For the classification of causes recommended by the Committee on Statistics of the International Association of Industrial Accident Boards and Commissions, see *Standardization of Industrial Accident Statistics*, U. S. Bureau of Labor Statistics, Bulletin No. 276, pp. 32-51.

formulated as to permit of expansion to meet the needs of industries or establishments for which a fuller analysis of any cause group is required and of summarizing in the case of groups of causes which play relatively minor rôles. An establishment or department with but a single type of machine may require a detailed analysis to indicate the particular points upon that machine where accidents occur or the particular processes which involve hazard, while an establishment with many varieties of machines is interested in knowing first upon which machines accidents occur most frequently and secondly how and where they occur. The analysis required by an industry or by a particular establishment for directing its own policies usually must be more detailed than that required simply for comparisons between establishments or between industries.

The value of comparing rates by causes in different establishments, as well as in different industries, lies in the fact that differences in specific rates reveal the influence of special preventive measures or the need for increased attention to prevention. Such comparisons, of course, like those between industries, can be made only if the cause classifications are on a comparable basis.

*In addition to statistics of causes, analyses of contributory conditions that may favor, or may be factors in, the occurrence of accidents are required.* These conditions are of two types, those that pertain to the worker and those that pertain primarily to the work. Among the former are included sex, age, marital status, illiteracy, race and nativity, ability to speak English, physical and mental condition; while among the latter are included such points as lighting, ventilation, arrangement or condition of the work-place, hours of work, rest periods, and other factors which may affect fatigue, efficiency, alertness, or the condition of the worker.

Some of the specific problems upon which light is needed are: Is the accident rate higher for men than for women workers in the same occupation? Is the accident rate higher for

children or young persons than for those in the prime of their working lives? Is the accident rate higher for persons nearing the retirement age? How is the accident rate connected with the health or mental condition of the worker? What is the influence of fatigue upon accidents? Would shortening the hours of labor diminish the accident rate? Is night work or overtime responsible for increased frequency of accidents? What is the influence upon accidents of insufficient lighting, poor ventilation, and other conditions that promote fatigue? And how, in practice, can these conditions be recognized, appraised, and corrected?

Each of the problems in this list, it is evident, requires special treatment and special material for study. The data required include not only the accidents that occur to different groups but also the man-hours of employment of each group—the exposure to risk of each group. In order to obtain significant and trustworthy results precautions must be taken to eliminate the influence of associated conditions and factors, and the difficulties involved in the procedure necessary to do this will commonly preclude any except intensive analytical studies.

The detailed statistics required can scarcely be described in general terms; they must be determined by the specific conditions of each case. A study of the relation between sex and accident requires data on accidents and man-hours of employment classified not only by sex but also by age and occupation. Differences in age composition of any two groups of workers whose accident rates are compared may be sufficient, if not taken into account, to invalidate conclusions, and it is obvious that differences in rates for the two sexes are significant only if comparisons are made for identical occupations. An analysis of the conditions that cause fatigue and their relation to the accident rate involves many difficult and technical questions. The facts available as to distribution of accidents by hour of the day suggest, for example, that the influ-

ence of fatigue is offset during the later hours by the psychological stimulus of approaching freedom. At any rate, existing data are unconvincing as to the importance or the unimportance of fatigue, because of the difficulty of isolating its true effects. A study of the influence of inadequate lighting can best be made by testing experimentally the effect of greater illumination upon the trend of accident rates. If improved lighting is accompanied by decreased risk it suggests, with sufficient emphasis for a practical conclusion, that inadequate lighting had a share in causing the greater original hazard.

Such studies vary greatly in respect to the practical applications that can be made of their results. In all cases, if they are to be of the greatest practical use, they must be made by experts in the type of problem under investigation and in close co-operation with those who are to utilize the results.

### **3. To Aid in Determining Methods and Policies**

Statistics for use in deciding methods and policies offer more difficult problems. If they are to be valuable they must bear on specific issues. But it is difficult to describe the data needed since the specific issues are constantly changing. Nevertheless, they may be summarized under four headings: first, data to show the effectiveness of a given method or policy; second, data to indicate whether the results are worth the cost; third, data to throw light upon the choices of methods or policies; and fourth, data to show their scope or the extent to which different methods and policies are used. The statistics already described are useful for these purposes but in some cases greater detail, or entirely new data, may be required.

The effectiveness of a given method or policy is frequently revealed by a detailed analysis of causes. Wherever a method of prevention is correlative with a specific cause, the analysis of causes shows directly the number and seriousness of accidents that it can prevent. Injuries to eyes by flying particles,

for example, can be prevented in the great majority of cases by wearing properly designed goggles. The number of eye injuries due to flying particles, therefore, indicates approximately the number of accidents which the wearing of goggles could prevent, and if, after the method was in general operation, such accidents continued to occur it would indicate either that the rules as to the wearing of goggles were not completely enforced or that the goggles were not of the right design for the purpose. A similar use can be made of data showing the number and seriousness of accidents caused by lack of safety guards on machinery. The occurrence of accidents of types which are normally prevented by such appliances should draw attention to gaps in the coverage of the laws or regulations or to lapses in their enforcement.

Data to show the relation between the probable results, including financial savings, due to introducing a given method or policy, and its cost form the second type of statistics that are helpful in determining methods and policies. They represent, however, not so much entirely new tabulations as combinations of material obtained for other purposes. The question whether it is worth while from the point of view of profits to eliminate a given type of specific hazard is one which involves a determination of policy on the part of the management. To take a concrete case, will it pay a coal mining company that is a "self-insurer" to introduce rock-dusting appliances to prevent explosions of coal dust? To answer such a question from statistical evidence would require data to show the probability of such explosions in the particular mine, the number of employees likely to be involved, the probable seriousness of injuries resulting, and the estimated cost of compensation, besides property damage, loss of orders and patrons, and other costs. With the total estimated cost of such explosions (discounted to the present), multiplied by the probability of their occurrence, must be compared the estimated (present) cost of the rock-dust installation. Of course, the practical decision may

not be determined solely in a given case by such a comparison, since the serious financial consequences that would result from a single mass-accident may suffice to convince the management of the wisdom of preventing such an occurrence at any reasonable cost. But often the introduction of preventive measures is delayed because of ignorance of their financial advantages.

In the more usual case where a coal mining company pays a premium to cover its liability for compensation arising from any type of accident, the comparison is between the amount of savings in insurance premiums that will be realized as a result of installing the rock-dusting apparatus and the cost of installation. The applicability of this method of comparison is, of course, limited to points of danger which can be identified as causes of specific accidents.

Analyses showing the number of accidents which it pays in dollars and cents to prevent and the number which can be prevented only at such cost as to make it unlikely that steps for their elimination will be taken serve not only to show employers where their interests lie but also to indicate to state legislatures and other policy-determining groups in what cases it is necessary to appeal to other incentives than the burden of cost.

In addition to statistics covering specific methods of prevention, detailed data are often desired by the public or by a particular industry or establishment to throw light upon the best choice of methods or policies. The question, for example, will it yield better results to spend money to eliminate unsafe conditions or to educate the workers to understand the need for careful methods? can be answered by data showing how each accident can be prevented. If the causes and circumstances of each accident are studied by experts who reach a decision as to how best it might have been prevented, and if these decisions are collected, classified, and tabulated, the results will throw light upon the relative desirability of available meth-

ods.<sup>12</sup> It should be emphasized, however, that such statistics are valuable only when based on verdicts rendered by experts. The value of the conclusions rests, indeed, upon the correctness of the individual decisions. Special studies based upon expert decisions are more valuable than large masses of material collected by uncritical methods.

Statistics in regard to the scope of application of methods and policies, or the extent to which they are used, should include surveys of the number and proportion of establishments and employees in each industry affected by these methods and policies. For example, how many establishments in each industry have safety organizations, and how many lack them? How many employees are there in each class of establishment? Are large or small establishments more likely to have adequate safety organizations? Of what types are they—safety departments, safety councils, or safety experts? What types of safety work do they carry on? Are there frequent meetings of foremen, or of all employees, for the promulgation of safety principles? By what methods do safety organizations operate? Do they utilize the records of different departments to awaken rivalries in promoting safety? A study of the scope of such organizations, in connection with details by types of agencies, methods of work, and results, would be most helpful in determining policies.

Especially needed are data to indicate the scope and thoroughness of inspections for the enforcement of safety laws. For each type of inspection service—for boiler hazards, elevator or fire hazards, mine hazards—data in regard to inspections should be tabulated in relation to the number of points of danger so as to answer the question: Are all hazards adequately inspected? With regard to the inspection of boilers, for example, are all boilers examined? If data to show the

<sup>12</sup> For an example of this procedure, see Chaney, L. W., *Causes and Prevention of Accidents in the Iron and Steel Industry, 1910-1919*, U. S. Bureau of Labor Statistics, Bulletin 298, pp. 201 and following.

total number of boilers in operation are not available there is no basis for judging the adequacy of scope of the inspections. This type of information is needed to enable legislators and administrators to judge the adequacy or insufficiency of appropriations. Are boilers inspected when installed? How often are they inspected, and what are the results of inspections in the form of condemnations and orders for changes? How are these orders enforced? What procedures, if any, are resorted to in attempting to enforce regulations? The details to be covered by such statistics should throw light upon all such inspection services, their scope, accomplishments, and limitations.

#### 4. TO TEST RESULTS

One of the chief purposes of statistics of occupational accidents is to test the progress and results of preventive work. For this purpose all the data previously described are of value. In the present connection, therefore, only those statistics which relate directly to testing prevention will be discussed.

In the first place, compilations of accident frequency and severity rates in successive years furnish a record of the progress or lack of progress in prevention. These data, therefore, should be maintained on a comparable basis.

This record is the only feasible comprehensive survey of occupational hazards. In the nature of the case, however, such a record shows the effects of other influences that bear upon the frequency of accidents. The accident rate may increase if dangerous new processes have been introduced or it may decrease if, because of industrial changes, fewer employees are engaged in dangerous occupations than before. The proper interpretation of this record, therefore, may require a detailed analysis of changes in exposure to definite hazards.

The trend of the rates by industries, occupations, establishments, and causes furnishes detailed information concerning the progress of specific prevention work which the combined

figures do not yield. The trend of rates in a specific industry, for example, is not affected by any decrease in employment or transfer of workers to another industry, though it may reflect a shift within the industry in the proportion of employees engaged in hazardous, as compared with non-hazardous, occupations. In case of a specific occupation or a specific cause the trend of the rates is even less subject to such influences but reveals directly the results of preventive efforts. An analysis by causes permits a study of the effects of preventive measures aimed at specific hazards.

In so far as specific agencies of prevention are at work in definite industries or occupations or upon the problem of eliminating specific causes, the trend of the figures for these industries, occupations, or causes can be used to test their success.

An important point that should be covered in the statistical tests of results is the effectiveness of inspections. A special tabulation of causes analyzed to show all the accidents of types that should have been prevented by existing inspection services would help to determine whether there is failure in any respect in these services and to suggest points where they might be improved or expanded.

## II. FOR ALLEVIATION

### 1. To Locate and Measure Losses

For an appraisal of the problem of alleviating the results of industrial accidents data to show the kind and amount of losses are required. These should cover type of physical injury—whether fatal, or resulting in permanent total, permanent partial, or temporary disability—and duration of the healing period, of absence from work, and of the incapacity itself. They should include the expenses of medical, surgical, and nursing attention, and of drugs and appliances of all kinds. They should cover all wage losses. Finally, they should include information in regard to the loss of earning capacity.

A complete record of losses incurred in accidents requires, of course, that all the accidents themselves be reported. It also requires that the reports with regard to each accident contain the necessary information on all the points mentioned above. With respect to the ultimate physical as well as the ultimate economic consequences, the preliminary report, of course, can give no final information. Nevertheless, it should include an estimate of the probable permanent injury, and a statement of the wages received by the injured, during, say, the preceding six months or, in case his earnings during that period were for some reason abnormal, his "usual" wages. This preliminary report should be supplemented by a subsequent report after the termination of disability or the return to work, or at the end of one year from the date of injury if disability is not terminated at that time. The subsequent report should include definite information both in regard to all medical expenses and in regard to the then estimated result of the case, with special reference to the permanent effect, if any, upon earning power. A final report on each case which does not end within the year should be made after its termination by death, recovery, or economic rehabilitation.

The classifications essential to full utilization of these data include the following: Medical, surgical, and nursing expenses should be related to detailed types of injury in order to furnish a basis for calculating average costs of such services for each type. Duration of the healing period, of absence from work, and of the incapacity itself should likewise be related to detailed types of injury in order to give a basis for determining a "normal" or average duration for each kind of injury.

Duration of the healing period in relation to the type of injury is useful for determining averages for purposes of comparison with standards. Such a comparison might suggest in a given case that the actual duration is unduly long, that there was malingering or delayed recovery, or possibly that there was delayed or insufficient medical assistance. Data regarding

the period of absence from work on account of injury are required for estimating wage losses and for checking up previous estimates of these losses based upon provisional figures.<sup>13</sup>

The duration of incapacity, in connection with its degree, is needed in all cases where partial incapacity extends beyond the period of absence from work. This incapacity may be removed or its degree modified by rehabilitation training. Data on these points are required to estimate wage losses in all such cases.<sup>14</sup> In fatal cases, as well as in cases involving permanent total disability, the wage losses must be estimated from figures showing the average expectancy of working life at the age when the accident occurred. For practical purposes, or in lieu of accurate and exact data, this may be taken as equal to 6000 days.<sup>15</sup>

<sup>13</sup> Strictly speaking, absence from work includes both absence during the healing period on account of injury, and absence after the healing period up to the time when a new position is obtained. In cases of temporary disability, unless the injured employee loses his position and is unable to find another promptly, duration of absence from work is equivalent for practical purposes to duration of the healing period. In cases of permanent disability, however, where the employee may be unfitted by the injury for assuming his old position, the healing period must be distinguished from the period of absence from work, and both from the duration of the incapacity itself. For most purposes absence on account of the healing period is the more significant, but cases in which the employee loses his position because of the accident should be specially tabulated and the duration of absence caused by the loss of position, as distinguished from that required for healing the injury, should be ascertained.

<sup>14</sup> In cases involving permanent partial disability (dismemberments) loss equivalents adopted for administrative purposes may be used also for rough statistical estimates. For example, the loss of a hand may be considered equal to 200 weeks of total incapacity. But there is need for statistical data with which to test the validity of such assumptions of equivalence.

<sup>15</sup> An alternative plan is to multiply the average wages by the expectancy of working life, taking into account the age of the injured. The latter method tends to rate the loss higher for the younger than for the older worker, since the former has a greater working life ex-

The tabulations can be based in most cases either upon preliminary reports or upon reports filed within one year after the accident. But to test the validity of assumed averages and the results of using estimates based upon preliminary reports, data from final reports must be used.

In addition to this material for measuring the economic burdens of accidents, data are needed to measure their social consequences. For the most part, these consequences can be studied and measured only by means of special investigations. One type of study is designed to trace the influence of accidents upon various social conditions; for example, groups of persons in receipt of poor relief or private charity are studied with a view to determining the part that the economic losses consequent upon accidents play in producing appeals for aid. Thus, the relation between accidents and poverty is investigated by ascertaining the influence of economic losses due to injury in bringing persons to destitution. A second, and perhaps more satisfactory, method of study follows the careers of victims of industrial accidents to determine what such accidents mean in terms of social consequences of all kinds. This matter furnishes answers to such questions as, for example, what proportion of the victims becomes dependent upon private or public charity?

## 2. To TEST MEASURES AND RESULTS

The chief points to be considered in testing measures and results are: the adequacy of alleviation and the efficiency of administration. The former applies to all measures (or lack of measures) for lightening the burdens of industrial accidents; the latter applies to specific measures, such as workmen's compensation, which are designed to provide benefits.

pectancy. But in so far as wage rates may be lower for younger than for older workers this effect may be partially offset by the difference in wages in favor of the latter.

Tests of the adequacy of alleviation should cover the subjects of medical benefits, compensation for wage losses, and rehabilitation training for the industrially incapacitated.

The data needed to test the adequacy of medical benefits include the following:

1. Duration of the healing period for each type of injury. The average durations can be compared with standards to indicate whether they are unusually long, and with past experience to determine whether changes are taking place. Any attempt to utilize such material in appraising the quality of medical care must, of course, be carefully safeguarded.

2. Interval between the time of injury and the time when first aid was rendered to show the promptness of medical aid. This is chiefly valuable for checking up on local (establishment) organization of medical services.

3. The number and proportion of establishments where immediate medical attendance and first aid equipment are available for injured employees during working hours, and the number and proportion of employees in such establishments.

4. The number and proportion of infected cases, classified by type of injury and duration of disability, with (if possible) analysis of the circumstances, such as delayed medical aid, that may have caused the complication.

5. Detailed figures in regard to the medical care rendered, such as number of visits per case, whether or not specialists were employed, nursing services, and other points relating to the kind and quality of care, classified by type of injury.

6. The number of cases, if any, in which medical care was restricted because of limitations in the law, for example, because of the provision in one state that limits medical care to two weeks.

7. The number and proportion of injuries for which no medical aid was received, classified by type of injury. Though chief interest centers in injuries serious enough to call for

medical aid, it is important to determine the character of the injuries that failed to receive medical attention.

8. The number and proportion of injuries cared for wholly at the expense of the injured, classified by type of injury.

9. Cost of care, if any, paid for by the injured, in addition to care furnished under provisions of workmen's compensation laws.

To test the adequacy of compensation for wage losses the following data are valuable:

1. Estimated total wage losses in comparison with estimated total compensation. These estimates must be based upon data showing on a comparable basis the duration of wage losses, the duration of compensation payments, the weekly amounts of wage losses, and the weekly amounts of compensation.<sup>16</sup> These figures should be subdivided according to the result of injury in order to show in which types of cases compensation is least adequate.<sup>17</sup> Not only should data on wage losses and on compensation payments be available but they should be worked up into an estimate, as fair as can be made, of these totals, in order that the true significance of compensation payments can be interpreted in terms of the relative proportion of wage losses borne by injured workers.

2. The number of cases in which wage losses occurred but in which no compensation was paid, and the amounts of such losses. These cases should be classified according to the reasons why benefits were not paid: if they occurred under an employer's liability law according to the reasons why no claim was presented or no damages were obtained; if under a compensation law according to the reasons why no claim

<sup>16</sup> If lump sums are paid in compensation the discounted value of the wage losses should be compared with the lump sum payment.

<sup>17</sup> In fatal cases attention should be paid to the adequacy of compensation to take care of the requirements of the dependent survivors. This requires special tables on the number of such survivors, the degree or extent of their dependency, and its duration.

was made or the ground on which it was denied. This analysis, if made definitely with the aim of throwing light upon these points, should be of great value in showing the importance of specific limitations or provisions of law.

3. The number of cases in which compensation was limited in amount or duration by specific provisions of law, classified by type of injury, and data to show how these limitations affect the adequacy of compensation. Duration of compensation payments, when contrasted with the length of the healing period (or absence from work on account of injury) should bring to light inadequacies in the grant of compensation and should show the effects of specific limitations on the period of such payments. Where there are no limitations on the duration of compensation the period of payments corresponds to the duration of the healing period. But maximum limits to the period or amounts of compensation specified for permanent total or partial disability may cause its termination before the injury is healed or before the need for compensation has ceased.

4. Figures showing the consequences of inadequate compensation, such as the number of appeals to charity or poor relief in cases where compensation was denied or was insufficient to meet requirements.

To test the adequacy of provision for rehabilitation the following data are required:

1. The number of those who have suffered losses in earning capacity on account of industrial accidents, classified by degree of loss and type of injury.

2. The proportion of these cases that would benefit by rehabilitation training. In addition to analysis by type of injury might be included, for example, data relating to the abilities and the previous training and education of the injured, since the more intelligent the individual and the more training or education he has had the more successful rehabilitation is likely to be.

3. The number of those who have received rehabilitation training. This figure should be compared with the estimated number of those who would benefit from it.

4. Results of such training in terms of wages before injury and before and after training, analyzed in relation to types of training given.

All data needed for such tests of adequacy of alleviation should be analyzed with reference to the type of measures in force, whether employers' liability legislation, workmen's compensation, or special laws for rehabilitating industrial and other cripples.<sup>18</sup>

Since the measures in force, when not merely establishment provisions, are mainly state laws, organization of the statistics by states (or jurisdictions) is essential. Important in determining the adequacy of existing compensation measures, moreover, are data to show, for each state that has a compensation law, the proportion of accidents which falls outside its scope, such as accidents in interstate commerce, in exempted industries, in establishments of less than a specified number of employees, and to workmen whose employers have elected not to come under compensation or who have themselves elected not to accept the provisions of the law. Statistics on this point may be based upon injuries classified according to whether they come within the scope of the compensation provisions of the law, or they may show the number and proportion of workers who are included within its purview.<sup>19</sup>

Light is needed also on the scope and adequacy of measures

<sup>18</sup> In addition to the statistics here described data are needed on the scope of voluntary insurance for accidents to workers. These should include, first, information relating to the injured, showing whether or not they carried insurance, and, secondly, data showing the number and proportion of workers in each industry and occupation who are protected by accident insurance, and the amounts of such insurance.

<sup>19</sup> Compare Hookstadt's estimates of the proportion of employees in different states who are covered by compensation; quoted on pp. 98-99 of this book.

of alleviation for accidents that fall under Federal jurisdiction. How many workers injured in such accidents obtain any measure of relief? Accidents to Federal employees, to railroad employees and other workers engaged in interstate commerce, and to workers, such as longshoremen, sailors, and others, who are comprised within the poorly defined admiralty jurisdiction accorded the Federal government by the Constitution should be classified according to whether they fall within the scope of any Federal measure for lightening the burdens of economic losses.

In addition to classification by states, an analysis of the medical data by establishments is useful wherever establishments are able and willing to supervise the kind and quality of medical care. Data for establishments, classified according to the quality of medical care offered so as to show the relation between adequate care and lessened duration of disability, are valuable to insurance companies and other agencies in demonstrating the value of first aid measures and in encouraging the creation of efficient medical aid departments.<sup>20</sup>

To test efficiency of administration of workmen's compensation laws or of other measures designed to provide benefits the following statistics are requisite.

1. A complete record of administrative acts in the form of numbers of claims filed, rejected, and approved, of payments made, and of cases closed.
2. Total costs of administration in relation to total benefits paid out in the same year.
3. Data showing for contested and uncontested cases the time intervals that elapsed between the date of injury, the

<sup>20</sup> Classification by industries with regard to the points covered here is relatively of little value. At the same time such a classification might throw light indirectly upon the effects of gaps in the laws in relation to specific industries. The omission of certain industries from the application of the laws is not always obvious when the laws themselves are examined.

filing of claim, the decision, and the first payment of compensation.

4. The proportion of appeals from decisions, the time required to adjudicate them, and the proportion of reversals on appeal. The last mentioned item throws light upon the character of the cases appealed as well as upon the quality of the original decisions.

5. Data relating to the correctness of decisions. These are important when such decisions are in the form of agreements made, for example, by employers and employees subject to approval by the courts.

### 3. To Aid in Determining Methods and Policies

Statistics needed for use in determining methods and policies are to a large extent the same as those required to locate and measure losses and to test the adequacy and efficiency of existing measures of alleviation. These show to the observant administrator or legislator where new provisions are needed and where existing measures should be supplemented and extended. Data that show the inadequacy of existing provisions for alleviation and the success or failure of methods already adopted are perhaps the most significant aids in determining methods and policies.

In addition to these statistics, however, data that bear on certain specific issues must be considered. The relative advantages of many policies can be determined only by studying comparative data obtained under fairly comparable, but not exactly the same, conditions. Thus, the only light obtainable upon questions of policy in one jurisdiction may consist of evidence as to the operation of the policy in another jurisdiction, because until the policy is tried the data necessary for testing its results in the first jurisdiction will not be available. Among the important issues that must be decided on such evidence are the relative advantages of workmen's compensa-

tion and employers' liability, the generosity with which compensation should be granted, and the mode of administration.

The issue of workmen's compensation versus employers' liability in most jurisdictions has been decided in favor of the former. Where statistics are available to test the adequacy of existing measures of each type they furnish perhaps the best information on this question of policy. A comparison of the proportion of cases of injury in which adequate remedy has been obtained under the two systems, either in different states during the same period, or in the same state after a change in system, throws significant light upon the issue. But in practice data on the results of employers' liability laws can be obtained only by means of special studies covering both the amounts of damages in excess of costs received in each case for which the law has been invoked, and comprehensive data on losses from all accidents, whether or not any damages were collected. Such a study would require comprehensive analysis of court records, and should cover the following data: the number and proportion of injuries for which claims were filed, suits brought, and judgments rendered; total and net damages in relation to losses; the cost of carrying on litigation; and the time between the accident and payment of the award.

The second issue upon which special statistics should be collected is whether or not more generous relief leads to more or fewer accidents. Since the relief afforded under compensation legislation is far more generous and certain than under employers' liability, statistics comparing accident frequency and severity rates before and after the adoption of workmen's compensation should throw light upon this issue. To the same issue data are pertinent which show the number and proportion of accidents in the production of which the desire for compensation might have played a part. Statistics of accidents wilfully caused also throw light on this question.<sup>21</sup>

<sup>21</sup> It is difficult to obtain accurate data on wilfully caused injuries and the figures obtained are doubtless to be interpreted as including only

The relative merits of existing methods of administering compensation legislation in the various states can be tested by means of statistics already described. Comparative data showing similar points for different methods afford a basis for selecting the most satisfactory, efficient, and inexpensive system of administering the law. Although such data must, of course, be interpreted with reference to differences between conditions in the various states, they should furnish statistical answers to questions relative to delays in decisions, fairness and correctness of awards, efficiency of payment and supervision, and cost of administration, on the basis of which judgments can be reached in regard to the administrative method to be preferred.

### III. FOR DISTRIBUTING COSTS TO INDUSTRY THROUGH INSURANCE

The data required to aid in distributing the costs of accidents to industry through insurance include: first, the cost of measures of alleviation assessed to industry; secondly, the distribution of these costs; thirdly, the scope of insurance and insurance methods; and fourthly, tests of methods and results.

To determine the cost of measures of alleviation requires details of unit costs for all types of accidents. Accidents occurring in a given year may lead to awards of pensions that may run for many years. The actual cost of these accidents can be determined only after the last pension payment has been paid. For practical purposes, however, this cost can and must be estimated in advance on the basis of statistical data. Such estimates are required to determine whether the premium rate for a given industry or establishment is sufficient to cover the most flagrant cases. Nevertheless, if careful study shows only an extremely small number of such accidents, the possible influence of the generosity of compensation under existing laws upon the number of wilfully produced accidents may be dismissed from serious consideration in making the final decision.

costs or is so high that it may safely be reduced. They are necessary, also, to determine the probable effect on costs of changes in the generosity with which compensation is measured. Estimates of cost made for the purpose of measuring premiums are, of course, subject to revision from time to time and must be tested by means of data on actual costs as soon as the latter are available.

The statistical data required to determine unit costs include as raw materials: (1) the cost per day or per week of pensions amounting to the specified proportions of wages; (2) for each type of injury the duration of the pension period in days or weeks; (3) the cost of medical and nursing services; and (4) administration expenses of all kinds, usually calculated as a percentage of other benefits. From these figures can be calculated, on the basis of an assumed rate of discount, the average net cost of each type of injury, or the average amount which must be set aside when each accident occurs in order to have a sufficient amount to cover the cost of all benefits payable on account of that accident.

These amounts show the net cost to industry of each injury of a specified type. They can be used, therefore, as previously suggested, to compare the costs assignable to specific causes with the expenses connected with preventing accidents from these causes.

As for the distribution of these costs, to calculate net premiums for a particular industry the total costs for accidents that may be expected, on the basis of the industry's accident rate, to occur, should be figured, and the result should be expressed in terms of average cost per one thousand employee years, or per \$100,000 of payroll. This ratio requires for its calculation, it is evident, data in regard to the costs imposed by the compensation laws according to type and severity of injury, as well as accident frequency and severity rates for the industry. When increased by a reasonable percentage for overhead expenses and profits, it gives the insurance premium

rate for the industry. Rates based upon such calculations assess or distribute the costs to each industry in proportion to risk.<sup>22</sup>

Statistics to show the scope of insurance methods should include: (1) data concerning the extent to which various types of insurance are in effect, in particular, figures as to the number and proportion of establishments and employees who come under self-insurance, under insurance by private stock and mutual companies, and under state insurance; (2) the number and proportion of establishments and employees in each industry that operate under schedule or experience-rating methods; (3) the number of insurance inspections; and (4) figures concerning the results of advice in regard to methods of prevention given by insurance companies and rating bureaus.

Finally, data are required to test methods and results. To test the results of assessing costs and distributing them through insurance requires an analysis of the trend of accident rates, interpreted in relation to such questions as whether the introduction of the assessment of cost principle has been accompanied by increased efforts at prevention, by increased appropriations for prevention work, or by decreased rates. To test the relative merits of schedule and of experience rating methods in their effect upon accident prevention, a close analysis of trend figures is necessary, coupled with data showing the prevalence of specific hazards for establishments assessed under each system. The relative advantages of different types of insurance carriers as distributors of costs should be tested by data on the ratio of overhead costs to compensation paid, in connection with data on the type and extent of services rendered by each such carrier.

<sup>22</sup> To throw light on the effects of these costs upon industry, data are required, (1) on the ratio of insurance costs to wages—data given by the premium rates themselves when stated in terms of payroll; and (2) on the ratio that wages bear to total costs—a topic, however, which falls in the general field of business statistics.

Tests of the efficiency of administration of insurance and of the quality of state supervision over insurance and over the granting of the privilege of self-insurance require data on the number of cases in which compensation, although technically awarded, was never paid or was not fully paid because of insolvency of the insurance company or of failure of the self-insurer. In addition, a detailed analysis of promptness of settlement of claims, and of promptness of payment of amounts due should throw light upon the efficiency of methods of insurance administration.

## CHAPTER IV

### APPRAISAL OF EXISTING STATISTICS OF INDUSTRIAL ACCIDENTS, COMPEN- SATION, AND INSURANCE

Having reviewed the requirements for statistics adequate to meet the outstanding needs that arise in connection with preventing accidents, alleviating their consequences, and distributing their costs through insurance, the next step is to appraise existing data with a view to discovering the gaps and deficiencies, as well as the excellencies, that characterize them.

#### I. SOURCES AND SCOPE OF AVAILABLE DATA

A brief survey of the sources of statistics of industrial accidents, compensation, and insurance will be helpful in forming a general idea of the scope of existing data. An important point to be considered is the character of the agencies that gather these statistics. The scope of the data gathered by any agency depends upon its interests and activities. The kind of analysis to which the material is subjected and the detail to which the analysis is carried are frequently determined by the purposes of the agency. The publication of the results, likewise—and the discussion will be limited to published statistics—is likely to depend upon whether the agency concerned has any responsibility for or interest in making the data available to the public or to persons interested in the control of accidents and their consequences.

Data on these subjects are gathered by public and private agencies. The former consist primarily of Federal and state

bureaus and commissions; the latter include insurance companies, safety councils, trade associations, labor unions, benefit funds, relief organizations, and individual establishments. Of the data obtained by private agencies, however, especially of those obtained by individual establishments, a large part is not published and hence cannot be considered here.<sup>1</sup>

Federal agencies that publish statistics of industrial accidents are the U. S. Bureau of Mines, the Interstate Commerce Commission, the U. S. Bureau of Labor Statistics, and the U. S. Employees' Compensation Commission. The Bureau of Mines publishes annual reports of accidents in coal and metal mines, quarries, metallurgical plants, coke ovens, and related establishments. The Interstate Commerce Commission publishes annual statistics of accidents on railroads. The Bureau of Labor Statistics publishes detailed analyses of accident statistics in the iron and steel industry, summaries of available statistics of accidents in other industries, compilations of state accident statistics, special studies of specific problems such as those that arise in accident prevention work, and reviews and summaries of foreign statistics of accidents and of other important publications in this field. The Employees' Compensation Commission publishes statistics of injuries to Federal employees for which compensation is claimed and paid.<sup>2</sup>

Federal agencies furnishing statistics of alleviative measures, in particular of compensation and rehabilitation, consist of the U. S. Bureau of Labor Statistics, the U. S. Employees' Compensation Commission, and the Federal Bureau for Vocational Rehabilitation. The Bureau of Labor Statistics publishes from time to time summaries of the statistics issued by state offices,

<sup>1</sup>Most of these data are useful only for the purposes of the agencies themselves.

<sup>2</sup>In addition to these, the Federal Bureau of the Census publishes statistics of deaths from all accidental causes in the Death Registration Area.

as well as statistical studies of special problems of compensation or rehabilitation. The data furnished by the Employees' Compensation Commission, as the name implies, are limited to figures in regard to compensation paid by that Commission to Federal employees. The Federal Bureau for Vocational Rehabilitation publishes studies and résumés of statistics relating to state and Federal rehabilitation work, which, however, is not limited to rehabilitation of industrial cripples.

Of the state agencies which publish statistics of accidents and compensation, by far the most important are the bureaus and commissions which administer workmen's compensation laws. In states which have no compensation systems statistics of accidents are likely to be neglected. The statistical output of other states depends, not only upon the type of law and the organization of the agency charged with its administration, but also upon the appropriations for this work and upon the interest in it shown by that agency. In states which have compensation systems administered either by commissioners working independently, or by the courts, the statistics published, if any, are likely to be limited to meagre statements of compensation claims and awards. In those where inspection work is closely linked up with compensation administration, the details of accident causes are likely to receive especial attention. Where the state offers compensation insurance, either through the compensation commission or a sister organization, the insurance aspects of the statistics are usually emphasized. The relative emphasis upon accidents, compensation, and insurance in the statistics thus varies from state to state.

In addition to the figures furnished by these agencies which have to do directly with the administration of compensation laws, inspection bureaus or services usually publish data on the scope and results of their work; for example, coal mine inspection bureaus publish statistics of fatal accidents in coal

mines. In states which have no compensation laws or no special bureaus for administering compensation, labor bureaus may have or assume the duty of publishing accident statistics. Furthermore, bureaus charged with the supervision of insurance issue statistics of their work, and vocational training departments report upon their activities.

The published statistical output of private agencies is difficult to summarize. Under the leadership of the National Safety Council, which has fostered a movement for improved accident statistics, a number of industrial or trade associations and of single establishments collect data and publish summaries of their accident experience. Individual establishments frequently keep detailed records of accidents for their safety departments to use as seems desirable; but these are commonly not published.

Of greater importance are the statistics gathered by casualty insurance companies. These data relate to the operations of particular companies and are essential to their rate calculations and financial management. Great pains, accordingly, are taken with the collection, interpretation, and analysis of the statistics. For the most part, however, they are not published; and if they were their limitation to the group covered by the insurance company would restrict their value for general purposes.

This brief review indicates the close relation that exists between the functions of an agency and its statistical output. It is perhaps to be expected, therefore, that the scope and character of existing statistics taken as a whole should be influenced by the almost haphazard distribution of functions among various agencies, by the gaps in provisions for compensation, by the failure of agencies to recognize possibilities of co-ordinating their efforts, and in particular by their failure to recognize the need for unified and co-ordinated statistics if the problem of accidents is to be dealt with adequately.

The scope of the data, so far as the range of subject matter is concerned, is indicated in a general way by the names of the agencies that collect and publish them. In detail their scope can be determined only by examining the publications in which they are set forth. But this examination is necessary also for any detailed criticism and appraisal of the statistics. Perhaps the best method of exposition, therefore, to indicate the scope of the data is to proceed to this detailed criticism and appraisal. This method, furthermore, has the advantage that it leads directly to consideration of necessary changes in the collection and publication of the data.

The limitations and defects in existing statistics may be discussed under three headings: (1) defects in existing data; (2) gaps; and (3) defects in organization of the system of statistics taken as a whole. In analyzing the shortcomings of available statistics the first and main inquiry will be with respect to defects in the data. It will then be a comparatively simple matter to summarize the most serious gaps, and to draw a few conclusions with regard to defects in organization. In the discussion emphasis will be laid upon data gathered and published by state and Federal agencies, since it is with regard to these that recommendations for changes will be made.<sup>3</sup>

The defects in existing statistics will be considered successively from the three angles of prevention, alleviation, and insurance.

\*In formulating a statistical program, the statistical output of private agencies must be considered in so far as necessary to avoid duplication by the government of work already competently performed. Furthermore, in making recommendations for filling gaps in the available statistical material, consideration must be given to private as well as to official sources. Frequently, however, the government may make data already compiled available and thus make an important contribution, or the government may take over the publication of data privately collected, in recognition of its own responsibility for the solution of these problems.

## II. DEFECTS IN STATISTICS FOR PREVENTION

The faults in data on accidents<sup>4</sup> which impair their value for use in prevention are of two types: defects in the original reports; and defects in tabulation, classification, and presentation.

### 1. DEFECTS IN ORIGINAL REPORTS

Defects in the original reports of accidents arise, in large part, from omissions due to incomplete reporting. The original reports of accidents are far from complete. Many accidents are never reported at all. But the proportion of omissions varies from state to state, from industry to industry, and from establishment to establishment.

*Omissions in reporting accidents tend to destroy the significance and comparability of accident rates.* Only if the data are known to be reasonably complete can rates based upon them safely be accepted at their face value. If omissions of smaller or larger extent occur in the original reports, the rates still may be useful as indicators of minimum hazards, but their value for comparative purposes, either with respect to trends or with respect to comparisons between different industries or establishments or between different localities, is impaired.

It is difficult to determine the extent of omissions as affecting published statistics of accidents. Light can be thrown upon the omissions by a study of the laws governing accident reporting, and of the relative efficiency of compulsory and voluntary methods, with special reference to responsibilities and incentives.<sup>5</sup>

<sup>4</sup>Of all the data needed for prevention accident statistics have received by far the greatest development. Accordingly, the survey will be devoted largely to an appraisal of these statistics.

<sup>5</sup>In addition, the statistics themselves sometimes give internal evidence of omissions. For example, an unusual distribution of accidents by severity is sometimes indicative of omissions, as when very few

*Inadequate reporting of accidents is due in large part to limitations in scope of accident reporting laws.* Most states have laws requiring work accidents to be reported to some specified body, usually the Compensation Commission or the Labor Bureau. In five states and in the District of Columbia, however, no provision is made for compulsory reports to state or district authorities. Obviously, in jurisdictions where no machinery is provided to receive and record accident reports, no data on accidents can be compiled.

So far as concerns accidents that come under Federal jurisdiction, compulsory reporting is required of all accidents that occur on railroads operating in interstate commerce. Accidents to Federal employees also must be reported by their immediate superiors to the Employees' Compensation Commission. On the other hand, reports of accidents to workers engaged in foreign commerce are not required, though jurisdiction for damages in such cases is placed by the constitution in Federal admiralty courts.

In states that have accident reporting laws specific limitations on the industries and occupations covered restrict the scope of the data obtained. In half the states, all employers are required to report accidents to their employees; in 20 this is required by law, and in four more by regulation.<sup>6</sup> But even in states with this broad coverage there are loopholes through which many industrial accidents may escape. Certain occupations are technically independent in character, for example, those of the newsboy and of the woman who takes in washing. Essentially, workers in these occupations have the same industrial or economic status as they would have under a accidents causing disability of less than one week are reported. Unusually low rates are also open to suspicion. These points, however, will not be examined here.

<sup>6</sup>In two additional states the law appears to require all employers to report, but regulations adopted by the industrial commissions interpret the requirement as applying only to employers under the compensation act.

contract of employment. But unless special provisions for covering them are made in accident reporting laws, accidents to such persons are not likely to be reported.

In one state establishments are required to report accidents only if women or children are employed. In another, only accidents in "extra hazardous" employments must be reported. And in three states the accident reporting law covers only a single industry—mining.

Only compensable accidents fall under the compulsory reporting requirements of 14 states. In these states, of course, all the provisions of law which limit the scope of compensation limit also the scope of compulsory accident reporting. All these states limit the occupations covered by their compensation laws. In all, agriculture and domestic service are specifically excluded; in four, non-hazardous employments or other occupations, such as public service or casual labor, are not covered; and in nine, establishments employing less than a minimum number of employees specified in the law—the number varying in the different states—are exempted from the compensation, and hence from the accident reporting, provisions of the law. Furthermore, in most of these 14 states, employers or employees must elect to come under the operation of the act and, in case they choose not to come under the act, presumably the accident reporting provisions of the law do not apply.

The total effect of these various limitations on the scope of compensation is shown in the proportion of the total number of employees who come under the compensation acts of the 14 states in which compulsory reporting is limited to compensable accidents. These proportions have been estimated as follows for the different states: Alabama, 33.6 per cent; Connecticut, 81.9; Delaware, 62.9; Georgia;<sup>7</sup> Illinois, 55.4; Kentucky, 60.2; Maine, 72.9; Nevada, 76.2; New Hampshire, 56.0; Rhode Island, 82.9; South Dakota, 58.0; Ohio, 76.3;

<sup>7</sup>No estimate available for Georgia.

West Virginia, 80.1; and Wisconsin, 75.4.<sup>8</sup> It should be stated, however, that no allowance was made in these estimates for the exclusion of employers and employees by reason of failure to elect to come under the compensation acts. Probably the proportion of accidents reported to the total number of accidents which occurred to employees in these states falls short, therefore, of these percentages.

The difficulties in the way of securing complete reports appear even greater under voluntary than under compulsory reporting systems. Nevertheless, under a well-organized voluntary system, fairly satisfactory statistics can be obtained by enlisting the co-operation of those who must furnish the data. Examples are the statistics of mine accidents published by the Bureau of Mines,<sup>9</sup> and the statistics of accidents in the iron and steel industry compiled by the Bureau of Labor Statistics.<sup>10</sup> The privately collected statistics of insurance

<sup>8</sup> Hookstadt, Carl, *Comparison of Workmen's Compensation Laws of the United States and Canada up to January 1, 1920*, U. S. Bureau of Labor Statistics, Bulletin No. 275, p. 35.

<sup>9</sup> These depend partly on compulsory reports of accidents made to state mine inspectors, copies of which are furnished to the Bureau, and partly upon data voluntarily furnished by mine owners in states where no reports are required. These voluntary reports are subject to difficulties in securing co-operation, failure to obtain which must result in omitting all accidents in mines that have not made returns. The data obtained cover substantially all accidents in practically all metal mines and quarries; in the case of coal mines they are limited to fatal accidents.

<sup>10</sup> These depend wholly on the willingness of employers to co-operate and in fact apply only to co-operating establishments, which, however, comprise the major part of the industry. In practice the omission of establishments is not serious since in the analysis accidents are related to man-hours of employment and both accidents and employment relate to the same establishments. For a valid rate it is necessary only that the accidents reported shall be complete for the establishments included in the tables. Of course such a rate may not apply to establishments for which no reports have been received. Even for these, however, the data are without doubt suggestive.

companies are also obtained without legal compulsion, although in this case a company may penalize an employer who fails to report by withdrawing his insurance protection.

To obviate these difficulties and to secure more nearly complete data under compulsory reporting, but still more under voluntary reporting, attention must be paid to selecting the most suitable persons to furnish the information and to securing their co-operation by providing adequate incentives. The information needed should be obtained from those persons who are in the best position to furnish it. Under compulsory reporting laws the duty of reporting is placed in practically all cases upon the employer.<sup>11</sup> Under voluntary reporting systems, too, the employer must be appealed to as a rule to make reports of all accidents to his employees.

In the former case penalties are imposed by law for failure to report—penalties which are rarely invoked. But under a compensation law injured workers or their dependents have an incentive to file claims and in filing their claims they report their accidents. In practice, under compulsory reporting systems reliance is placed to a large extent on the filing of claims. Under voluntary reporting systems, on the other hand, neither penalties, nor rewards in the shape of compensation, can be invoked. As a result, incentives in the shape of useful statistical analyses of accidents, their causes, and the methods by which they may be prevented, must be relied upon.<sup>12</sup> Under compulsory reporting systems, where no compensation is provided for, such analysis also plays an important part, as in case of the reports of accidents furnished by the railroad companies to the Interstate Commerce Commission,

<sup>11</sup> In some states, physicians in attendance are required to report on the nature of the physical injury. In case of accident to a United States government employee his immediate superior must make a report.

<sup>12</sup> The Bureau of Labor Statistics in its analysis of accidents in the iron and steel industry, and the Bureau of Mines in its studies of mine accidents, rely largely upon this incentive.

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which analyzes their causes in forms of value in furthering prevention.

Failure to report accidents is more likely to occur when the injuries are minor than when they are serious. Not only are minor accidents more subject to variations in interpretation of what constitutes a reportable accident, but their relative unimportance may lead to their being ignored entirely. Especially is this true in cases of insignificant injuries, which, however, are sometimes followed by serious infections. Claims are likely to be filed for compensable accidents. But since compensation is greater for serious than for minor injuries the reporting of the former is probably more complete. Similarly, the reporting of injuries that require medical attention, especially those in which medical services established by the employer are called upon, is probably more complete than the reporting of those in which no medical aid is sought.

*Differences between definitions of reportable accidents lead to lack of comparability of the statistics.* A great variety of definitions is to be found in the various state and Federal jurisdictions. Although for the most part of minor importance they lead to defects in the original data and call attention to the need for uniformity.

In 12 states only must all accidents be reported, but in 16 more all resulting in disability lasting more than one day are reportable.<sup>13</sup> One state sets the minimum duration of disability for reportable accidents at two days; one at one week; seven at "over one week"; one at ten days; one at two weeks; and one at "over two weeks."<sup>14</sup> These

<sup>13</sup> Of these 16, five require all accidents with disability lasting one day or more to be reported, and three require reports of all accidents involving disability or loss of time; six of the 16 add accidents in which medical aid is required, irrespective of the existence or length of disability.

<sup>14</sup> The three states in which accident reports are required from mines only are omitted in this list, as well as the five in which no accident reporting law is in force.

limits show the wide variety of different practices prevailing.

In addition to these limitations based upon a minimum duration of disability, which are stated in part in the accident-reporting and in part in the compensation laws, other limitations are found in the laws of states in which only compensable accidents are reportable. For example, in the majority of these states, to be compensable an injury must have arisen "in the course of employment" or "out of the employment," or both. Such provisions are subject to various interpretations in the courts. These limitations, however, are probably of greater significance in affecting compensation than in affecting accident reporting, since in cases of doubt accidents are probably often reported even if the payment of compensation is contested.

Under the law which requires the reporting of accidents on railroads the Interstate Commerce Commission has authority to determine the definition of reportable accidents. The regulation in force covers accidents either in which a person was so injured that during the 10 days following the accident more than three days' disability resulted,<sup>15</sup> or in which \$150 damage was done.

*Defects in reports of accidents arise also from the failure of report forms to call for important items.* A study of forms used in the various states discloses in a few cases more or less serious omissions. In one state, for example, no question is found about the cause of accident. The form used in another state omits the sex, and that used in a third the age, of the injured. In many states the information called

<sup>15</sup>This rule applies to employees injured; the rule applicable to other persons injured is that the accident is reportable "if the injury is sufficient, in the opinion of the reporting officer, to incapacitate the injured person from following his customary vocation or mode of life for a period of more than one day." Interstate Commerce Commission, Bureau of Statistics, *Accident Bulletin*, No. 93, calendar year, 1924, p. 1.

for with regard to cause is incomplete. The forms in use in perhaps a majority of states provide no spaces for suggestions as to how the accident might have been prevented.

*Lack of uniformity in the details called for by the report forms used in the various states impairs the value of the statistics for comparative purposes.* Great variety appears with respect to the causes of accidents. Even greater diversities are found in the details called for with respect to accident prevention. It should be possible to reach agreement upon the minimum points which should be reported for all accidents and upon a uniform report blank. Additional information, if any, required for the administration of the workmen's compensation act of each particular state could be added on a supplementary form.

In addition to defects in the original data on accidents, defects in the original data on exposure to risk must be considered. These include not only the entire absence of exposure data but also defects which cause lack of comparability with the corresponding reports of accidents.

*Lack of data on exposure impairs the value of many published reports on accidents.* This is true particularly of state statistics. Only three or four states have made any attempt to relate accidents to exposure in order to ascertain relative risks. So far as Federal statistics are concerned the fullest use of data on exposure is made by the Bureau of Labor Statistics in its analyses of accidents in the iron and steel industry. Although the data on accidents and on exposure in terms of man-hours of employment do not cover the entire industry, yet they are compiled along parallel lines and, as a result, the rates obtained are on a sound basis. Not only is this true of the rates as a whole, but also it is true of detailed rates by branches of the industry, by departments, and, so far as the analysis is carried, by occupation, age, and other factors. In the reports of the Interstate Commerce Commission railroad accidents are compared with the number

of man-hours of exposure; they are analyzed according to railroads and according to occupations. In the reports of the Bureau of Mines, accidents in mines, though not analyzed by occupations, are compared with exposure calculated roughly in terms of man-hours of employment. Neither in the statistics of railroads nor in those of mines, however, is any attempt made to obtain severity rates as distinguished from frequency rates. Nor is any attempt made in the statistics of accidents to Federal employees, published by the U. S. Employees' Compensation Commission, to compare accidents to exposure.

A special difficulty with statistics of exposure is that frequently they are available only as a result of special censuses which are not related specifically to accident statistics either in scope or in time. Hence, in comparing accidents with exposure, various differences exist which render the two sets of data not exactly comparable. Gaps may be due to difficulties in obtaining co-operation. The figures regarding exposure may be available for all except a few establishments while those regarding accidents relate to all; the basis of classification by industry may not be exactly comparable in the two sets of data; or the available data on exposure may not be for the right time. Further, in most cases, exposure is available only in terms of average employment or of man-days rather than man-hours of employment. But even though affected with a considerable margin of error, comparisons of accidents with exposure are still valuable in so far as they permit valid conclusions to be drawn with regard to relative hazards.

For detailed study of causative conditions and factors in accident hazards, such as nationality, sex, age, and lighting, data on accidents are practically worthless without corresponding data on exposure. For example, statistics classifying accidents by nationality are of little or no value without comparative data classifying exposure in a similar manner. Ex-

cept for special studies made by the Bureau of Labor Statistics and perhaps some other agencies there are practically no significant statistics on these points. State data concerning these conditions and factors, if available at all, are limited to accidents.

## 2. DEFECTS IN TABULATION, CLASSIFICATION, AND PRESENTATION

Turning from this review of the original data, the defects in tabulation, classification, and presentation of the statistics based upon them are next to be considered.

*Lack of uniformity in the units tabulated and in the years or periods to which the figures relate impairs the value of the data for comparative purposes.* The adoption of a uniform definition of accidents<sup>16</sup> for purposes of tabulation is most important in promoting comparability, since by its aid many minor variations both in definitions of reportable accidents and in the completeness with which minor accidents are reported can be prevented from having any influence upon the statistics. To some extent such a definition has been adopted. For example, the Bureau of Labor Statistics uses in its statistics of accidents in the iron and steel and other industries the definition of "tabulatable accidents" recommended by the International Association of Industrial Accident Boards and Commissions,<sup>17</sup> and the Bureau of Mines uses a closely corre-

<sup>16</sup> Or the injuries that are sustained—each individual injured in an accident should be counted as one injury or accident.

<sup>17</sup> "Tabulatable accidents, diseases, and injuries. All accidents, diseases, and injuries arising out of the employment and resulting in death, permanent disability, or in the loss of time other than the remainder of the day, shift, or turn on which the injury was incurred should be classified as 'tabulatable accidents, diseases, and injuries' . . ." *Standardization of Industrial Accident Statistics*. Reports of the Committee on Statistics and Compensation Insurance Cost of the International Association of Industrial Accident Boards and Commissions, 1915-1919, U. S. Bureau of Labor Statistics, Bulletin No. 276, p. 17.

sponding, if not identical definition. Certain states, furthermore, base their statistics of accidents upon this definition of "tabulatable accidents."<sup>18</sup> The majority, however, use all compensable accidents as the basis for their statistics.

As for the time unit to which accidents should be related, the logical basis for tabulation is the accidents that occurred during the period to which the statistics relate. The accident data published by the Interstate Commerce Commission, the Bureau of Mines, and the Bureau of Labor Statistics, are based upon this principle. Those of the U. S. Employees' Compensation Commission, however, are based for the most part not upon accidents or injuries but upon awards of compensation.<sup>18</sup> The bases for state tabulations include variously accidents which occurred, approved claims for accidents which occurred, and compensation cases closed during the period.

Differences in periods of time covered by statistics, though not perhaps of first importance, lessen their comparability. The most satisfactory period for statistics of accidents is the calendar year. The reports of the three Federal agencies which tabulate the accidents that occurred during the period all relate to the calendar year. Those of the U. S. Employees' Compensation Commission, on the other hand, relate to accidents during the fiscal year (ending June 30). State reports relate in perhaps the majority of cases to the calendar year, although some relate to the fiscal year, which may end in June, as in most states, or in September, or at some other period. The period of time covered in most states is one year, but in some it is two, and in others four years.

Defects in classification and presentation of accident data are of three types: insufficient analysis or inappropriate detail in classifications; failure to compare accidents with exposure; and lack of comparability where comparability is required.

<sup>18</sup> That is, upon injuries of such types that compensation was claimed and awarded.

*An outstanding defect in many published reports of accidents is insufficient analysis.* As developed in a preceding section, adequate analysis of accident data requires classification by industry and cause. The work of Federal agencies in gathering statistics of accidents in railroading, in mining, and in the iron and steel industry is organized on an industry basis, and the cause classifications are developed in accordance with the requirements of the particular industries. The causal analysis of accidents to Federal employees<sup>19</sup> appears less satisfactory, partly because a wide variety of kinds of work is found in the Federal service, and partly because the major emphasis is not on prevention but on compensation.

The data furnished by the states, on the other hand, must be characterized for the most part as fragmentary or insufficiently analyzed. Of the 42 states which compile accident data of one kind or another, nine publish only the number of fatal and non-fatal accidents, three publish such data classified by industries or for a single industry only, while only 30 attempt analysis by industry, cause, nature of injury, and other factors. In 1920, 22 states published data by industries,<sup>20</sup> 18 classified by causes, and 12 by result of injury (whether fatal or resulting in permanent total disability, permanent partial disability, or temporary total disability) with or without the details required for calculating severity rates. While the value, in connection with the movement for prevention of industrial hazards, of data showing the number and seriousness of accidents in the several states with detail by industries must not be minimized, the most useful analysis, that by both industry and cause, is attempted in only nine states.

Some states, perhaps, are too small or have too little indus-

<sup>19</sup> Available only for the year 1919-20. U. S. Employees' Compensation Commission, *Fourth Annual Report*, pp. 145-166.

<sup>20</sup> The number, as well as the states, included in this list varies from year to year.

trial development to justify any high degree of classification in the state figures themselves. Their establishments, however, form part of national industries, for all accidents in which detailed analyses by industries and causes are essential to effective prevention. Accordingly, any attempt to appraise existing data from the point of view of their usefulness in prevention cannot avoid pointing out the uselessness of the insufficiently analyzed state data now available. At the same time this does not necessarily constitute a criticism of any state office for failure to carry classifications beyond the point where they would be valuable to the state considered by itself. A system that expects the required data on all points to be analyzed and published by the smaller states may itself be at fault.

*Inappropriate detail in analysis tends to destroy the usefulness of existing statistics.* In this connection the classifications of industries and of causes call for special comment.

The fundamental basis for an industrial classification of accident statistics is similarity of hazards. Such a classification is needed to throw light upon significant causes of accidents and upon significant methods of prevention. But in the industrial classifications used in certain states little attention is paid to this principle. In some states, for example, the groupings are too broad; in one all manufacturing industries are included in a single group; in another all industries except coal mining and metal are lumped together. Such broad groupings are of little value in prevention work.

An illustration of inappropriate analysis of causes is furnished by a table in which two principles of classification are confused. Among the "sources" of accidents are given "belts and pulleys," "burns and scalds," "falling and jamming," "machinery," "sprains and strains," and so on. But a sprain may be caused by falling and hence the allocation of such an injury is not clear. Furthermore, the term "sprain" furnishes little information as to how the accident occurred and throws no

light upon how it might have been prevented. As stated elsewhere, the cause classification should be designed to show how accidents are caused in order to show how they may be prevented.

*Failure to compare accident data with comparable data on exposure constitutes a serious defect.* This is due, of course, largely to the entire absence of data on exposure, though in part to lack of comparability between the data on accidents and those on exposure. For frequency and severity rates both the accidents and the man-hours or man-days of exposure must be classified, for example, by industries. But lack of comparability between the industrial classification of accidents and that of exposure renders these rates subject to large errors and seriously impairs their value. The only way to be sure that both sets of data are similarly classified is to have them gathered at the same time and compiled in the same way by the same office. When, as in the case of most accident statistics, returns of accidents are incomplete and certain establishments, or certain entire industries, or large portions of an industry, are entirely omitted, the value of the result becomes uncertain and difficult to ascertain. Nevertheless, even though subject to a large margin of error, such data are better than none, provided the industry groups are sufficiently broad and provided stress is not placed upon small variations.

*Lack of comparability with respect to industries and causes destroys the possibility of suggestive comparisons between the accident rates of different states and establishments.* Such comparisons would serve to reveal the industries and states where accident prevention work is in a backward condition and would thus help to spur them on to more effective work.

Dissimilarity is found in the industry classifications used in different states. In the largest group of states, 10 out of the 30 which have accident data classified by industries, the

grouping recommended by the Committee on Statistics of the International Association of Industrial Accident Boards and Commissions is followed in the main. Twelve states use classifications which in part, at least, parallel this standard classification or which furnish combinations corresponding to those of the standard. But in other states various classifications are in use, no two alike, but each based roughly upon a list of the industries found in the state in question.

As for causes, 14 of the 24 states which publish data on causes follow the main outlines of the classification recommended by the Committee on Statistics of the International Association of Industrial Accident Boards and Commissions. But in the groupings used by these states differences in detail appear, and differences are to be found also in the allocation of different combinations of causes. In the remaining 10 states various other classifications are in use.

Lack of comparability further prevents the combination of data from different states and a more extended analysis of the combined material by industries and causes than is possible for the more meagre data from a single state. This limitation is, indeed, a most serious failure in state accident statistics. The characteristics of industry do not depend upon state lines nor are methods of prevention determined by state boundaries. Hence a system of collecting accident data which limits their analysis by industries and causes to single states constitutes one of the most serious shortcomings in the statistics of industrial accidents.

*Lack of continuity in comparable form constitutes another serious defect in accident statistics.* A series of reports containing full and detailed analyses is in too many cases followed by reports limited to the most meagre data. Without a continuous series of statistics on accidents and accident risks the progress of prevention cannot be tested adequately. The whole progress may be jeopardized for lack of intelligent guidance based upon a record of achievement.

## 3. OTHER DEFECTS /

With regard to other aspects of statistics of industrial hazards, state figures in general suffer from lack of centralized direction, lack of application to specific problems, and hence lack of significance. The statistics of inspection services illustrate these points. Such data commonly are restricted to a bare record of the administrative acts performed by inspectors—the number of inspectors, the number of inspections of various kinds, and in some cases the number of orders issued. Rarely the data cover the number of danger points ordered to be remedied. But, commonly, the relation of this work to the problem as it exists in the state is ignored; no data are available to show how the number of inspections compares with the number of points of danger which need to be inspected; no light is thrown on the frequency with which each point of danger is inspected; and no information is given to show whether or not the inspections are adequate. The really significant aspects of inspection work from the viewpoint of prevention are almost universally ignored.

## III. DEFECTS IN STATISTICS RELATING TO ALLEVIATION

In reviewing the existing statistics on alleviation it will be taken for granted that in all states data relating to the fiscal operation of the state compensation office—to the amounts appropriated, the amounts received in premiums, and the amounts disbursed—are available. Such material is essential to the operations of the state treasury. But it is with statistics which throw light upon the problems of alleviation that we are particularly interested. How are the burdens of losses alleviated? Are measures for lightening these burdens adequate and satisfactory? Do available data answer the questions raised in the discussion of the problems of alleviation?

*For testing the adequacy of benefits, the statistics of allevia-*

*tion published by most states fall far short of their possibilities.* As a record of benefits awarded, the available data are limited to states with compensation laws and to occupations covered by such laws. For states without compensation laws data on alleviation are almost completely lacking, since no systematic statistics are compiled either concerning injuries for which no damages are claimed through the courts or concerning the results of damage suits. Even for states that have compensation laws data for uncompensated accidents are almost entirely lacking. Only one state publishes reports of fatal accidents that for one reason or another did not come under the compensation act or did not receive compensation. Furthermore, the available statistics of alleviation for compensable accidents are not complete. For a number of states only the barest statement of the total amounts paid out for compensation is available. Comparatively few states publish a detailed statistical record of medical benefits, compensation and rehabilitation granted. Commonly, too, no attempt is made to compare injuries sustained with injuries compensated in order to show the number and proportion of uncompensated cases of each type of injury. Some states, however, present a partial substitute for such a comparison in the form of tabulations of rejected claims for compensation with reasons for rejection.

So far as medical care is concerned, the statistics in general are fragmentary. In the majority of states the data are confined to, (1) the number of cases which received medical attention, and (2) the cost of treatment. In many states only total cost is given and not cost for each type of case. In certain states the facts are not available because the benefits received are paid for outside the scope of the law on a contract basis or through special assessments on employees' wages.

For only a few states are data available to show the duration of medical care or of the healing period, in relation to

type of injury, an item which bears a direct relation to the adequacy of medical benefits.

Data on the number and proportion of infected injuries and on the duration of medical care required in such cases are given consideration in only a few states. These data throw light upon the adequacy of provision for medical aid, since prompt attention to injuries and proper care should prevent infections in the majority of cases. The duration of care in such cases, when contrasted with its duration in normal cases, should throw light also upon the importance of preventing infections.

Statistics relating to compensation for wage losses in some states cover only total amounts expended, but in the majority they show total and average amounts for each type of injury. With regard to the adequacy of such compensation, however, little information is available.<sup>21</sup> Statistics on the ratio of compensation payments to wage losses are commonly not published as such; it is frequently assumed that the statutory provisions governing the proportion compensation bears to "wages" (as defined in the law) cover the point. In this connection, data contained in a special study made by the Bureau of Labor Statistics show the effects of various limitations in the laws, for example, as to the weekly maximum or the waiting period, in restricting the adequacy of compensation.<sup>22</sup> Special studies made in one state of the circumstances of families receiving compensation benefits also bear upon this question.<sup>23</sup>

Data on rehabilitation, where provision for rehabilitation is

<sup>21</sup> The data on the number and proportion of cases which received no benefits of any kind, already discussed, throw light upon the inadequacy of compensation for wage losses.

<sup>22</sup> See Hookstadt, Carl, *Comparison of Workmen's Compensation Insurance and Administration*, U. S. Bureau of Labor Statistics, Bulletin No. 301, pp. 66-71.

<sup>23</sup> See *Report of the Industrial Accident Commission of the State of California from July 1, 1921, to June 30, 1922*, p. 32.

made, are limited for the most part to statements of administrative activities, applications filed, applications granted, cases trained, and cases discharged. Usually no attempt is made in statistics published by the states to relate this information to the extent of the problem or to measure the success of the work by statistical tests.<sup>24</sup>

Statistics for testing the efficiency of administration are likewise meagre. Data on the intervals between filing claims, making decisions, and paying awards are now published from time to time in several states; and a special study of the subject with reference to the type of law and its administration has been made by the Bureau of Labor Statistics.<sup>25</sup> A number of states publish data on appealed cases, although usually with reference to their number and disposition rather than with regard to the time required for reaching decisions or to their character.<sup>26</sup>

#### IV. DEFECTS IN STATISTICS OF COSTS AND INSURANCE

Most states publish summaries of total receipts and disbursements on compensation account and for the expenses of administration. These data are necessary for accounting purposes, the latter in all compensation states, and the former in all cases where a state body, such as a state insurance fund,

<sup>24</sup> See Cahn, Reuben D., "Civilian Vocational Rehabilitation," *The Journal of Political Economy*, December, 1924, Vol. XXXII, pp. 665-689.

<sup>25</sup> See Hookstadt, Carl, *Comparison of Workmen's Compensation Insurance and Administration*, U. S. Bureau of Labor Statistics, Bulletin No. 301, pp. 10-12.

<sup>26</sup> Special studies of the correctness of the awards given and agreements reached under compensation acts have been made. See, for example, *Ibid.*, pp. 13-17; and "Three Years under the New Jersey Workmen's Compensation Law," Report of an Investigation under the Direction of the Social Insurance Committee of the American Association for Labor Legislation, *American Labor Legislation Review*, March, 1915, Vol. V, pp. 31-102.

receives premiums and pays benefits. Even in states which have no insurance funds the total amounts of compensation paid out yearly are often tabulated, though the information is of little value.

*Though most states publish figures relating to amounts disbursed, few publish data on costs incurred each year because of accidents.* For insurance purposes and to determine the total burden of costs imposed by accidents upon industry data are required upon the total costs incurred because of injuries rather than upon the total amounts paid out each year. Among the materials that throw light upon the costs incurred, or the total costs, on account of accidents of each type which occurred during a given year may be included estimates of costs incurred, figures relating to payments made plus estimated figures relating to future liabilities for payments, and figures relating to the total amounts paid out on cases closed during the year.

Data on costs available to insurance companies or to their rating bureaus for their own operations furnish their actuarial and statistical departments with a basis for calculating rates and costs independently of state reports. But since costs are dependent on the provisions of state laws on compensation, to be useful they must be classified by states or else be utilized with special reference to the unit elements into which they can be analyzed. Data derived from insurance company experience have the advantage, from the point of view of calculating costs, that they are closely related to the special type of experience with which the company deals, but, if limited to the experience of a single company, they may suffer from the disadvantages due to limitations in coverage. These data for the most part are not available in published form.

*With regard to the extent to which different insurance methods are used only meagre data are available.* States with competitive state insurance funds usually publish data showing

the relative proportion of insurance business that goes to each type of carrier. Many states publish details relating to the granting of the self-insuring privilege. Data on the consequences of bankruptcies, either of self-insurers or of insurance companies, are not available in systematic form; such failures are relatively rare and their effects are difficult to summarize with regard to compensation payable in any one state.<sup>27</sup> No data are published on the scope of experience and schedule rating methods. Little information is available in regard to the scope of different types of services rendered by insurance companies in the way of inspections and helpful suggestions for aiding prevention or in regard to the results of these inspections and suggestions.<sup>28</sup>

Special studies have been published of overhead costs, or the cost of administration of different types of insurance in relation to the services rendered.<sup>29</sup>

## V. GAPS

On the basis of this survey the principal gaps in the available data may be briefly summarized.

In the statistics of hazards the principal gaps are:

1. In several areas and jurisdictions no data on accidents are available; in others, the data are far from complete.
2. Data on exposure are mostly wanting. Except for three industries, railroading, mining, and iron and steel manufacturing, there are no comprehensive nation-wide statistics of accident risk.

<sup>27</sup> See Hookstadt, Carl, *Comparison of Workmen's Compensation Insurance and Administration*, U. S. Bureau of Labor Statistics, Bulletin No. 301, pp. 20-21, 64-65.

<sup>28</sup> See Michelbacher, G. F., and Nial, Thomas F., *Workmen's Compensation Insurance, Including Employers' Liability Insurance*, p. 41.

<sup>29</sup> See Hookstadt, Carl, *Comparison of Workmen's Compensation Insurance and Administration*, U. S. Bureau of Labor Statistics, Bulletin No. 301, pp. 5-21.

3. Comprehensive data on the prevalence of points of danger are lacking. Except for statistics of grade-crossings, practically no data of this type are published.

4. Data on the scope of preventive methods are not available.

Gaps in the statistics of alleviation are more extensive, though perhaps individually less serious, than in statistics of accidents. They include:

1. Omissions of losses wherever gaps in accident statistics exist.

2. Practically complete absence of statistics of losses and of damages recovered in states and jurisdictions operating under employers' liability laws.

3. In many states, practically complete lack of data on the granting of medical benefits, on compensation, and on rehabilitation; and in these and others, on the extent of losses of various kinds due to accidents.

4. In many states lack of adequate data in regard to the administration of compensation laws.

Since these data must be organized by states (or jurisdictions) to be of greatest value in furthering measures of alleviation, gaps may be said to exist wherever in any state or jurisdiction all the data required for determining losses and appraising measures of alleviation and their administration are not available.

Gaps in the statistics of costs and insurance, like those in the statistics of alleviation, must in general be stated with reference to particular state jurisdictions, because both costs of compensation and insurance practices are largely governed by state laws. For most states neither statistics of total costs incurred on account of accidents nor the data required for calculating unit costs are available. Statistics are lacking also in some states with regard to the prevalence of self-insurance and of other types of insurance and, generally, with regard to the scope of insurance methods and services.

## VI. DEFECTS IN ORGANIZATION

The chief defects in organization of the statistical services which deal with industrial accidents have been hinted at in the preceding discussion. From the point of view of accident prevention the outstanding defect in the organization of these services consists in the fact that responsibility for the statistics is split up among many independent state offices with resulting lack of unified tabulation and analysis. Centralization is needed to put the data on a uniform basis, to secure such analysis as will contribute effectively to the solution of the problems of each industry, and to fill existing gaps in the statistics.

Since statistics of alleviation and insurance relate essentially to particular jurisdictions, the defects in organization of the services furnishing data on these subjects are not to be found in lack of centralization but in the independent agencies themselves. Where the state office entrusted with the function of alleviation interprets its duties narrowly or is circumscribed in its work by lack of funds or lack of authority the results are not satisfactory and many problems are neglected. These state bureaus and commissions, however, can be aided in solving their organization and administration problems by studying the work of similar agencies in other areas and by studies of comparative data made by various research bureaus, such as the investigations made by the U. S. Bureau of Labor Statistics.

General defects in the organization of the statistical services, such as those arising from insufficient authority, from lack of co-operation between the statistical and administrative branches or between alleviation, prevention, rehabilitation, and inspection services, or from insufficient funds, can be remedied only through a realization on the part of the public of the need

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for improved statistics and of their importance in controlling the problem of industrial accidents. But information furnished by adequate statistical services is thus an essential element in correcting these defects.

## CHAPTER V

### A PROGRAM FOR ACCIDENT STATISTICS

In outlining a program for the extension and modification of statistics of accidents for use in prevention and alleviation, the specific recommendations made will be limited to state and Federal, that is, to governmental statistics. The tabulations of statistics that bear upon problems of public interest is properly a government function. Though the original data must be gathered in large part by individual establishments or by private insurance companies and may be profitably utilized by them for their own purposes, nevertheless, so far as the public at large or the industries as a whole have an interest in the results, the state or Federal government is responsible for tabulating and making the statistics available.<sup>1</sup> But the greatest defects in the data at present collected are due to the scattering of effort among many agencies and to failure to focus results upon problems, defects incident to the disorganized state of statistical services performed by many distinct and separate agencies. Hence, in outlining the program for accident statistics, particular emphasis should be placed upon the need for selecting such agencies and such methods of collecting data as will best promote the solution of these problems.

<sup>1</sup>If private agencies, for their own purposes, are willing to undertake these activities and perform them in such a way as to meet all legitimate needs, there is no good reason why a governmental agency should duplicate the work, though it might properly, in discharge of its responsibilities, offer to take over and defray the cost of tabulations.

## I. PREVENTION .

The two outstanding requirements in statistics of accidents are: (1) for each industry a body of data analyzed by causes for the use of the industry in solving its problems of accident prevention, and (2) for each state comprehensive data for the use of legislative and administrative agencies in determining their policies toward preventing accidents and alleviating their unprevented consequences.

*The analysis of accident statistics for major industries by causes in relation to exposure is preeminently a field for Federal or national statistical services.* In three industries, as already indicated, this analysis is already made by existing Federal agencies. For one or two others beginnings have been made by private initiative under the leadership of the National Safety Council. For all industries for which existing data are inadequate, Federal or national services should be created to furnish on a national scale statistical compilations of accidents and analyses of accident problems. Each industry should receive the benefit of special and expert advice based upon statistical analyses of the causes of its accidents.

The fundamental data on accidents are already present in their essential features in the original reports made by or to the employer or establishment. In the majority of states the employer is required to file reports of accidents with the state agency which administers the compensation law. All insurance companies which write employers' liability or workers' compensation insurance also require reports of accidents. In addition the safety departments of the larger and more progressive establishments have at their disposal complete files of original reports, and all employers commonly require foremen or other supervisors to notify them of every accident.

The fundamental data on exposure, furthermore, are al-

ready available in most establishments in the records of hours worked, which are kept for pay-roll purposes.

The problem of securing adequate statistics on accidents and exposure for analysis by industries and causes may be attacked in three possible ways: (1) through compilation by a Federal agency of tabulations made by state offices; (2) through tabulation and analysis by a Federal agency of data collected by state offices in states belonging to a "registration area"; or (3) through collection, tabulation and analysis by a Federal agency of data secured directly from individual establishments.

Compilation by a Federal agency of tabulations made by state offices<sup>2</sup> requires of these offices uniformity of detail in preparing their tables and comparability of data on accidents and exposure, with respect to definitions, completeness of reports, and industry and cause classifications. Though this method would make use of the state machinery already in operation for the compulsory reporting of accidents, the value of the results is sure to be impaired, in fact, by variations in definitions and in the scope of reporting laws, by gaps and omissions in the reports, by failure on the part of some states to tabulate the returns, and by differences between the methods of tabulation and the classifications used in other states. Furthermore, few states have made any attempt to obtain data on exposure to correspond with their data on accidents.

Not only are the existing materials not suited to form the basis of such a compilation, but the practical difficulties in the way of making them so by securing state co-operation in using uniform methods and classifications are so great as to render the method unfeasible. Even if all the states were willing and anxious to co-operate, the difficulties in the way of securing uniform interpretation of cause and industry classi-

<sup>2</sup>For an example, see Chaney, L. W., *Statistics of Industrial Accidents in the United States*, U. S. Bureau of Labor Statistics, Bulletin No. 339.

fication in a large number of independent statistical offices would be well-nigh insurmountable. But experience has indicated that the different states are extremely slow to make the modifications of their laws required to produce uniformity, and that in general state offices are reluctant to undertake to collect data on exposure, because they fear that to ask for additional data might imperil the co-operation they are already receiving from employers in filling other statistical demands. Furthermore, it is almost too much to expect that state offices will carry through tabulations which seem of little value for their own purposes for the sake of furnishing data for a general compilation made by a Federal agency. And, finally, even if all these difficulties could be overcome, further analysis of results that might appear significant would be rendered difficult, if not impossible, by the fact that the compiling office would not have the original data. This method, in short, does not promise fruitful results because it leaves to state initiative the gathering of uniform accident and exposure data and their uniform tabulation—two fundamental elements in results which will benefit, not the states as such, but the industries.

The second possible method of securing this result is through the establishment of a registration area for accidents analogous to the registration areas established by the Census Bureau for births and deaths. States could be admitted to this area as soon as their accident recording was up to the standard set for admission. Copies of accident records sent to the state offices could then be made and forwarded to a Federal agency for tabulation and analysis. By such a method a Federal statistical service could obtain the basic data for compilation. This method would have all the advantages due to utilizing the system of compulsory accident reporting already built up on state lines and at the same time would be independent of state arrangements for tabulating the data.

On the other hand, this second method, like the first, would be subject to variations in definitions and in the scope of

accident reporting laws, and to gaps and omissions in accident reporting so far as these occurred in the states admitted to the registration area. Like the first method it leaves the initiative for correcting such defects to the states. The alternatives open to those administering the area would be either to have but few states in the area or to allow considerable latitude in the conditions for admission. Especially difficult would be the question of exposure data, since for use in calculating accident rates, data on exposure are of little value unless they correspond closely with data on accidents. Either both sets of data must be complete for the states admitted to the area, or the gaps in one set must be made to correspond exactly with the gaps in the other. In the former case all the difficulties would have to be encountered which are mentioned in the discussion of the first method so far as concerns uniformity in the data on accidents and exposure furnished by the several states. In the latter, it would be necessary in practice to abandon the state and adopt the industry and the establishment as the basic units for the collection of accident and exposure statistics. But if industry and establishment furnish the best basis for accident and exposure statistics there seems to be no good reason for limiting the statistics arbitrarily to selected states, and the machinery of a registration area seems unnecessary.

The third method of securing adequate data is for some Federal statistical service to obtain duplicate reports on accidents and exposure directly from the individual establishments. This places upon the establishments to be benefited by the tabulation direct responsibility for furnishing all the original data. Obviously the success of such a system depends upon the convincing of employers, particularly those who are not obliged by law to report their accidents,<sup>3</sup> that the statistical

<sup>3</sup>Where reports of accidents and exposure had already been filed with state bureaus in accessible form the data could be obtained by making copies of these reports.

results are sufficiently valuable to justify the cost. This method has the advantage that data on accidents and exposure can be asked for and obtained in comparable form for identical establishments. By including only establishments for which both sets of data are available, accident frequency and severity rates can be compiled and calculated on a sound basis. By placing the responsibility for tabulation in a single office uniformity in methods and classifications can be secured and the results can be focused upon satisfying the needs of the industries for data to guide their preventive activities.

*Of these three possible ways of meeting the need for more adequate data for use in accident prevention the method of compilation by a Federal agency from records furnished directly by the several establishments offers the best prospects for valuable statistics.* As already noted, it places directly upon the industries which are to utilize the results responsibility for furnishing the basic data. In return it provides a complete statistical analysis adapted to the needs of each major industry and prepared on a nation-wide scale. To prepare data that satisfy the requirements for use in prevention it does not depend upon uniform action by state legislatures or by state tabulating offices, many of which are concerned solely with the compensation provisions of the law.

Such a solution of the problem of securing adequate statistical analyses of accidents by industries and causes for purposes of prevention does not obviate the need for state accident reports. These are required for guidance in putting into operation those types of preventive activities for which the state is responsible, as well as for purposes connected with alleviation. Where state action, in the form of protective legislation or legislation prohibiting certain types of hazards, is the best method of prevention, data should be available to show the specific need for such action in each state. Where inspection by state officials is required to enforce laws and regulations, data on accidents which should have been prevented by effi-

cient inspection are needed to test the inspection services. And until national figures on accidents and exposure are available the only recourse is to state statistics already in existence.

*The requirements of states for statistics to guide legislative and administrative policies can best be met by improving existing state statistics.* The program should include: (1) extending the scope of accident reporting so as to cover all industries and all accidents, (2) improving the quality and completeness of reporting, and (3) making the data more homogeneous and uniform both in details obtained and in classifications, so that their comparison with other data will yield significant results. These points may seem mere matters of detail, but the enumeration in the preceding chapter of defects in the existing data suffices to indicate the possibilities of improvement which their elimination would make possible.

The adoption of sound cause and industry classifications, whether for state or for national statistics, is of great importance. The classification of causes proposed by the International Association of Industrial Accident Boards and Commissions, with its possibilities of increasing the amount of detail given for particular industries, appears to be satisfactory. The uses of statistics of causes are admirably served by this classification, which provides not only the details necessary to aid prevention in each specific industry but also the broad groupings needed to permit significant comparisons between different industries and establishments.

The classification of industries offers greater problems because of the many and varied uses, in addition to the measurement of risks and the determination of insurance premiums, for which such a classification is needed. A classification of industries is required, for example, for production, employment, and business statistics. This fact raises the question whether all industry classifications should not be uniform, so that the data collected for one use may be utilized for other purposes. If they were all uniform, data on employment classified by in-

dustries, for example, would be comparable with data on accidents, and their comparison would yield valid accident rates for the different industries. But pending a general solution of this problem, the wisest method of classifying accidents is to conform as closely as possible to the principle that the industrial divisions should be based upon similarity of risks. The organization of accident statistics on a national scale along industrial lines would not only permit of drawing these lines so that they would be significant from the point of view of administering prevention work, but would make possible such sub-divisions as the character of the hazards called for; and in any case the data on exposure to risk, when gathered for the same establishments, would be comparable with those on accidents. Aside from the statistics of accidents proper, other classes of data needed for use in prevention call for immediate development.

*In the first place, surveys of hazards and points of danger by establishments and industries should be encouraged.* Such surveys are definitely helpful in furnishing exact information in regard to the existence of preventable hazards. This information should be available by states, since certain types of hazards, for example, explosions in coal mines, require for their prevention that the state provide legislative or other remedies. Surveys of this character should be made, (a) by state inspection bureaus which can compile reports made by their staffs, (b) by establishments acting either independently or under the guidance of an industrial association or of a research organization (such as the Bureau of Labor Statistics), or (c) by insurance inspectors whose reports can be tabulated to show the number of the principal kinds of hazards found in the establishments they have surveyed. In any case, the data should, of course, be made available to the particular establishments concerned.

*In the second place, statistics relating to the extent to which methods of prevention are used should be developed.* The

progress of prevention should be measured, not only in decreasing rates of accidents but also in increasing application of successful methods. Data on the prevalence of preventive methods should be developed through agencies concerned with the nation-wide spread of the safety movement. For the most part, these means of prevention are not peculiar to particular industries. In each industry organizations concerned with the application, on a nation-wide scale, of statistics to accident prevention would be interested to know the extent to which methods applicable to their industry are in use. Variations in prevalence of such methods in different establishments, in different states, and in different localities would suggest points where intensive work is needed. But for these purposes the data must be obtained on a uniform basis so as to permit valid and significant comparisons.

*In the third place, state and Federal statistics of safety inspections should be reorganized so as to show whether the inspection services are efficient and sufficiently comprehensive.* Inspections are for the purpose of bringing about local and specific prevention. The data should show the local requirements for prevention as revealed by inspections and also the results accomplished. The principal value of the figures is found in the light they throw upon whether the inspections in a given state or jurisdiction are efficient. They are, therefore, essentially state (or jurisdictional) statistics.

*Finally, statistical researches into the more technical and difficult problems should be instituted and carried on under direction capable of insuring valuable and sound conclusions.* These problems include not only those mentioned above, but also such questions as the effect upon accidents of fatigue, hours of labor, working conditions, inadequate lighting, and other factors. These researches should be entrusted to governmental agencies equipped with data, personnel, and appropriations sufficient to handle research problems of this character. Such agencies should be selected not only with a view to

carrying out investigations in a scientific spirit but also with a view to their ability to comprehend the problems that call for solution, and to decide upon investigations which have the greatest promise of yielding results capable of useful application.

## II. ALLEVIATION

The outstanding changes needed in statistics of alleviation are their re-orientation and development to make them throw light upon the adequacy of alleviative measures. This requires the creation of new statistics where necessary to cover points not now covered; the reorganization of existing data to place them in significant relationship to injuries and losses; and special statistical analyses to answer specific questions as to the adequacy of this or that feature of alleviation. In view of the wide diversities in quality and scope of existing statistics of alleviation in different jurisdictions, the program must necessarily be stated in general terms.

New data, to be obtained only by special studies, are needed to expose the inadequacy of indemnification for injuries through employers' liability legislation, not only in the few states which still have this system, but also in those fields in other states that are not yet covered by compensation laws, and in occupations and industries subject to Federal jurisdiction which are still outside the benefits of such legislation. These statistics, though difficult to obtain, would be of value because they would show the need for changing the type of remedy. A difficulty in their collection is that, in the absence of direct instructions on the subject from legislative bodies, existing governmental agencies appear reluctant to amass data that point so clearly to the need for new laws for fear they may be criticized for seeking to influence legislation. As a consequence, privately financed studies undertaken by organizations or by public spirited citizens are frequently relied upon for such data. But clearly the duty of furnishing light upon

the shortcomings of existing legislation as a method of alleviation belongs to the state or Federal government which is responsible for the weal of its citizens.

To disclose the inadequacies of compensation laws new or additional data are needed in regard to those accidents which, though occurring in industries covered by such laws, fall for one reason or another outside their scope. These should be analyzed according to their severity, according to industry, according to wage and other losses, and according to the provisions of law because of which they were not compensable. Tabulations showing the reasons why claims for compensation were denied are also useful. The cost of medical care and rehabilitation training provided at the expense of the injured should be covered in special tables.

The existing data on benefits should be expanded, where necessary, to show the actual benefits of each kind granted for injuries of each type. Medical benefit tables should show the duration of the healing period for each kind of injury. The number of cases of infection and their duration by type of injury should be tabulated. Amounts of compensation received should be compared with wage losses in tables designed to show, on the one hand, the general adequacy or inadequacy of the benefits provided for in the law, and on the other, the effects of specific limitations. Rehabilitation training should form the subject of tables compiled to show the relation between the provision made and the need. Tables based on surveys of the economic condition of those who received training, made at an interval after its completion, would throw light upon its efficacy.

Special tables should be developed to meet the special requirements of the situations found in each state, in order to show what changes in the existing law or in its administration are required to make the compensation provisions more adequately fulfil their purposes.

Tables relating to the administration of the laws should

be complete for each state or jurisdiction upon at least three points: (1) the time required for adjudicating claims; (2) the promptness of payment; and (3) the correctness of awards. The first two should be routine tabulations. The latter can be covered by special studies made from time to time and is needed particularly in jurisdictions where decisions on claims and the making of awards are not under the immediate jurisdiction of a state body charged with the administration of the compensation law.

In addition to these statistics for each state, special statistical comparisons should be made of methods of administration and of policies in order to aid in improving the operation of the laws. On many questions of policy the issues are substantially similar in all states. In a single adequate investigation a Federal agency could collect the pertinent data and make them available, once for all, to all interested legislative and administrative bodies. In this category come, for example, studies of the effect upon the frequency of accidents of granting, in cases of temporary disability, benefits equal or nearly equal to wage losses; studies of the prevalence of accident neuroses under different methods of granting compensation; and studies of the crippled man in industry under different policies in regard to rehabilitation. In this field a state agency is frequently handicapped by lack of funds, and in any event such an agency is subject to special difficulties in making investigations that extend beyond state lines.

### III. COSTS AND INSURANCE

The three outstanding requirements for statistics in the field of costs and insurance are: (1) costs for purposes of determining net premiums; (2) administration and overhead costs, which, together with those for determining net premiums, yield the information needed to determine gross premiums; and (3) data on the scope and methods of insurance.

Since the costs of benefits awarded under compensation laws vary from jurisdiction to jurisdiction according to the generosity of the benefits, the data must necessarily be organized by states or jurisdictions. Information available for one will not necessarily be applicable to another. In other words, although premium rates have to be formulated without exact data, since they are applicable to the future while available data relate to past experience, nevertheless, data for each state on the actual costs of accidents and on the compensation paid for injuries are requisite to accurate premium determination. As previously developed, the data needed for this purpose—including the average and distributed costs of medical benefits and compensation for injuries of each type—should be made available for each jurisdiction in such form and in such detail as will best meet the requirements.

Data on the costs of administration, not only of state compensation offices, but of state compensation insurance funds operating either under competitive or under monopolistic conditions, and of private mutual and stock insurance companies, should be expanded, where not already developed, so as to be comprehensive.

The statistics as to the scope and methods of insurance should be expanded in all jurisdictions so as to include: (1) the extent to which self-insurance is permitted; (2) losses to beneficiaries due to bankruptcy of insurance companies or of self-insurers; (3) the extent of insurance carried by different types of companies and by state funds; and (4) the prevalence of specific methods, such as the furnishing of inspection and advice, used by these companies and funds.

**PART II**  
**THE WORKERS' HEALTH**



## CHAPTER VI

### PROBLEMS OF THE WORKERS' HEALTH

The problems connected with the workers' health require illumination from three points of view. In the first place, the character and size of the problem of ill-health should be ascertained to determine the magnitude and direction of the efforts required for its solution. Secondly, the causes of disease and of physical defects should be analyzed with a view to developing specific measures and methods for protecting the health of workers. Thirdly, ways and means should be devised for alleviating losses, whether due to decreased incomes from inability to earn wages or to increased expenses for medical care, and for distributing them in such a way as to lessen their burden.

#### I. THE EXTENT OF ILL-HEALTH

The extent and consequences of ill-health among workers must be realized if there are to be focused upon the problem remedial measures adequate to cope with it effectively. Such knowledge can result only from a thorough-going survey of the morbidity and mortality of the industrial population. It is needed by industry, by workers, and by the public. Sickness interrupts production and this concerns industry; the places of the sick must be filled, either temporarily if an early return of the worker is expected, or permanently if extended disability or death results. It interrupts income and thus concerns the worker and his family. The loss of wages and the increased expenses for medical, surgical, and nursing care

caused by sickness produce a strain, more or less grave, depending upon the duration and outcome of the illness, upon the budget of the worker's family. This strain, when sufficiently serious, breaks down the family as a self-supporting unit and thus concerns the public, which must solve the resulting problem of poverty and dependence.

The forms of ill-health that concern the worker and his family include those which influence the worker's efficiency and enjoyment, as well as those which cause absence from work, disability, and premature death. They include all minor ailments and physical defects that are responsible for diminished output even though such ailments or defects may not have given any evidence of their presence in pain and suffering. These types of ill-health are important also to industry and to the public because of the consequences that may follow from neglect, since in many cases apparently unimportant symptoms develop into serious diseases.

Sicknesses that cause absence from work form the major type of ill-health concerning which information is needed. The extent of such illness can be measured by the duration of the absence from work. Of special importance is information concerning cases of communicable diseases which lead to epidemics in shops, thus causing many to be absent.

Of the diseases and sicknesses that cause absence from work, those are by far the most serious that lead to permanent incapacity or premature death. In these cases the losses caused by the interruption to income are the heaviest. They last for the longest period. In cases of permanent incapacity the expenses caused by sickness, if adequate care is provided, are likely to be unusually high. In such cases the family, in addition to providing a substitute for the lost income, has the heavy responsibility of caring for and supporting the sick man. If death occurs, extra expenses for care cease, but the family is faced immediately with the problem of supporting itself. In either case industry must take steps to train an-

other man to take the place of the worker lost. And in either case society loses the services of the trained worker. In fact, the consequences to industry and to society of permanent incapacity are the same as those that follow in case of death.

In other cases of sickness that cause absence from work the consequences that flow from loss of income and from extra expenses required are similar to those that follow disabling injuries, though as a rule less serious.

Knowledge both of disease and of its consequences draws attention to the need for prevention on the one hand and for alleviation on the other. From the point of view of control the immediate problem is to discover the best means and methods of preventing ill-health and, when it has not been prevented, of alleviating its physical and economic consequences. To these subjects, therefore, attention is directed.

## II. PROTECTION OF THE WORKERS' HEALTH

The protection of the workers' health, to state the problem in its broadest aspect, requires not only knowledge of the nature of the hazards to be considered but also study of ways and means for safeguarding health and information to test the efficiency of adopted and proposed measures.

*Solution of the problem of protecting the workers' health must be based upon knowledge of the points where health is menaced.* It is at these points that measures must be applied to eliminate health hazards. What groups of workers are most subject to disease? To what types of disease are workers especially exposed? In what respects do they require special protection? Do existing infirmities or physical defects render them more subject to other ailments? What are the existing physical characteristics of the working population that affect their resistance to disease or to bad environmental conditions?

Not only must the personal liability of workers to sickness be recognized as part of the problem, but even more necessary

is a study of the types and seriousness of exposure to which workers in different industries and occupations are subjected. In what industries and occupations are health hazards greatest? The answer to this question shows where the greatest efforts are required if the health of industrial workers is to be adequately safeguarded.

*The analysis of causes and causative conditions is essential to an understanding of industrial health problems.* Studies of the causation and frequency of sickness and premature death must be made to throw light upon the specific diseases and ailments that produce ill-health. Knowledge of the nature of the ailment is of course essential not only to its treatment but also to an understanding of how it is caused and of how it can be prevented.

Study of causative conditions that favor or produce ill-health is also essential in any comprehensive program of health protection. The environmental conditions that surround the worker must be analyzed to discover those elements that are deleterious. Studies of the effects of inadequate ventilation, of too long hours of employment, of too prolonged standing at work, or of fatigue caused by the strain of work or by insufficient rest periods would throw light upon general factors in the causation of ill-health. Knowledge of the influence of these factors is necessary as a guide to the measures required to protect health.

*Furthermore, health protection in industry requires knowledge of the influence of occupation and occupational processes upon health.* Detailed analysis of the relationship between occupation and illness is a necessary step in discovering the points at which menaces to health originate, or toward which they are focused. Such analysis is preliminary to determining measures appropriate to prevent these effects, for wherever ill-health is found to be due to a specific occupational condition appropriate remedial measures must be applied to this condition. The remedy must be adapted to the responsible condi-

tion or cause which should be understood to include not only specific disease, but also the circumstances in which work is carried on, the materials used in the process, the amount and character of exertion required, the extent of exposure to dust and fumes, to the weather, or to excessive cold or heat, and similar occupational conditions that might affect health.

Of special interest are the so-called occupational diseases, in the narrow sense of the term, over the causation of which the responsibility of the occupation is peculiarly close. As examples may be cited anthrax, the wool sorters' disease; lead poisoning, met with in all trades that have to do with lead; caisson disease, which affects those who work under high air pressure; "phossy jaw," associated with exposure to phosphorus; carbon monoxide poisoning; poisoning due to contact with benzene or its derivatives; and necrosis of the jaw due to exposure to radium or mesothorium used in the manufacture of "radiolite" watch dials.<sup>1</sup>

But the relatively greater ease of demonstrating the responsibility of industry and occupation over the health of employees in cases of these occupational diseases should not lead to neglect of occupational factors in the occurrence of other types of illness. The prevalence of pulmonary tuberculosis, for example, is greatly increased by occupational conditions that involve exposure to metallic or stone dusts. Respiratory diseases may be affected likewise by the conditions of employment, such as exposure to heat or cold. A careful and thorough analysis of the statistics of sickness classified by occupations and by causes, with the influence of differences in age and sex distributions eliminated, is necessary to show the effects of occupational and industrial conditions upon the prevalence of ill-health.<sup>2</sup>

<sup>1</sup>For a comprehensive treatment of occupational poisoning, see Hamilton, Alice, M.D., *Industrial Poisons in the United States*.

<sup>2</sup>See, for example, Robinson, D. E., and Wilson, J. G., *Tuberculosis among Industrial Workers*, Report of an investigation made in Cincinnati, with special reference to predisposing causes, U. S. Public

*The study of specific causes of sickness and of the causative conditions which affect health should lead to systematic elimination of industrial health hazards.* Recognition and identification of causes are merely the preliminary steps; their elimination or modification is the ultimate goal.

A program of health protection must embody effective methods and measures for eliminating or modifying health hazards and their causes. The means to be employed must be determined by technical experts working in co-operation with medically trained industrial hygienists. The variety of these means is as great as the variety of specific health hazards they are designed to meet. In general, however, they are of two types: those which completely eliminate the hazard by prohibiting the use of the dangerous processes or materials; and those which attempt, more or less successfully, to modify the conditions so as to minimize the danger to health. The former include both prohibitions imposed by law or regulation and bans adopted voluntarily by employers. The latter include not only technical devices and changes in processes designed to modify the hazardous nature of operations but also measures of health protection designed to lessen the prevalence of sickness among industrial workers.

*Abandonment of dangerous processes or materials may be required in the interest of the workers' health.* If the dangers of the process or material cannot be eliminated satisfactorily by other measures abandonment may be necessary. As a familiar example may be cited the discontinuance of the use of white phosphorus in the manufacture of "strike-anywhere" matches, accomplished in most countries by legal pro-

Health Bulletin No. 73. The occupation needed is the occupation of the worker at the time the disease was contracted. Not much sickness, even tuberculosis, is found in industrial establishments or among those at work. Furthermore, after a disease has been contracted the worker frequently leaves the occupation that was responsible and finds employment in some "lighter" trade.

hibition but in the United States by means of a special tax levied by the Federal government in conjunction with the generous offer of the holder of the patents to permit other manufacturers to use the relatively safe sesquisulphide process.<sup>3</sup> As other examples may be mentioned the abandonment by the British government, on the discovery of a satisfactory substitute, of the use of the dangerous tetrachlorethane as "dope" for varnishing airplane wings<sup>4</sup> and the prohibition in France (projected) and in Belgium of the use of lead in paints.<sup>5</sup>

*The workers' health may be safeguarded by technical methods which reduce hazards to a minimum.* In this category are included such measures as hoods to take away dangerous gases, gas masks to protect men whose work requires exposure to deadly fumes, and methods and processes of manufacture which reduce such exposure to a minimum. Many improvements in methods of manufacturing and handling dangerous chemicals may be required to render their use as safe as possible for the workers employed.<sup>6</sup>

The program should include not only methods of protection against dangerous processes but also treatment of the sick and medical supervision over the health of employees.

<sup>3</sup>Hamilton, Alice, M.D., *Industrial Poisons in the United States*, pp. 312-314.

<sup>4</sup>See remarks by Dr. Alice Hamilton in Public Health Bulletin No. 158, p. 99. Also, "Dope Poisoning in the Making of Airplanes," *Monthly Labor Review*, Feh., 1918, Vol. VI, pp. 289-316.

<sup>5</sup>"In France . . . in 1909, a law (which would have come into force in 1914 had not the war intervened) was passed prohibiting the use of lead in paints." Hamilton, Alice, M.D., *Industrial Poisons in the United States*, pp. 197-198. A Belgian law passed March 30, 1926, effective six months after that date, prohibits the sale of white lead and other pigments or colors containing white lead and their use in painting the interior of buildings. . . . *United States Daily*, June 28, 1926.

<sup>6</sup>For a description of technical processes in relation to the workers' health in the white and red lead industry, for example, see Hamilton, Alice, M.D., *Industrial Poisons in the United States*, Chapter 12, pp. 163-170.

*Suitable treatment for the sick is an essential element in any program for improving industrial health.* Treatment adequate to and appropriate for particular diseases and defects must be made available to sick workers. Methods of treatment constitute a technical medical problem and will not be discussed here. In this connection the important point to note is the need for making medical knowledge available in practical forms to industrial workers by providing access to skilled medical attention which, otherwise, they might be unable to secure.

Measures which provide medical assistance are important, as well as measures which provide funds to defray the expenses involved in adequate care. The latter will be discussed in a subsequent section of this chapter; the former call for brief mention.

*To protect the health of industrial workers, an adequate staff of physicians trained in industrial and occupational health hazards is essential for proper diagnosis and treatment.* The training of such physicians must, of course, include special preparation for the diagnosis and treatment of diseases arising from occupations, together with such preparation in public health work as will fit them for supervising the health of workers under their charge. The problems of training, however, cannot be considered here. The point to be emphasized is simply that adequately trained physicians must be available to render the necessary medical and health services to industrial workers.<sup>7</sup> And the provision of such assistance through the generosity of the employer, or through the co-operation of employer and employee, or through trade union or other benefit funds or clinics constitutes an important part of an adequate health program.

Among other valuable measures for the protection of the health of workers must be considered the industrial clinic, the

<sup>7</sup>See remarks by Henderson, Yandell, M.D., in Public Health Bulletin No. 158, p. 97.

comprehensive health survey, the provision of instruction in hygiene and of recreational and gymnasium facilities, and the giving of preventive treatment for incipient disease.

*The industrial clinic is an important adjunct of industry in protecting the health of employees.* It mobilizes the health protective resources of an establishment (or an industry) in a single organization under a medical director or industrial hygienist. Its cost is usually borne entirely by the establishment; but to the establishment accrues the benefit from increased efficiency of employees, from lessened absence on account of sickness, and from improved morale of the entire working force. Upon such an organization can be placed the responsibility for planning and carrying out in all its details the establishment's campaign for health protection.

*The health survey of all employees furnishes the basic facts necessary for individual health work.* Because such surveys or examinations show where special treatment is needed, they must be ranked among the most valuable means for raising the level of health among workers. Individual health examinations repeated at intervals make it possible to avert serious ailments that can be prevented if detected early. By determining in specific instances the presence of disabilities that require change of occupation or lessened physical strain, such surveys or examinations make possible better adaptation of workers to their work and prolongation of their working lives. By presenting a picture of the health status and resources of workers in industry they furnish the basic data needed for appraising the value of other health measures.

*Instruction in industrial hygiene is an essential element in the protection of the workers' health.* This is especially true in those occupations and processes where workers are exposed to specific dangers. For example, in occupations involving contact with lead, among other precautions<sup>8</sup> scrupu-

<sup>8</sup> Particularly precautions against breathing lead in dust form, which is now believed to be responsible for most cases of lead poisoning.

lous cleanliness is necessary to prevent the absorption of lead poison by transfer from the hands to food or directly to the mouth. In general, educational work designed to acquaint each worker with the health hazards to which he is exposed and with the measures he should take to guard himself against these dangers is an invaluable means of health protection.

*The provision of recreational and gymnasium facilities tends to promote industrial health.* These facilities give to employees the opportunity, and suggest to them the advisability, of caring for their health through recreation and physical exercise. They add to precept the force of example. They add to instruction on health matters an invitation to participate in health-giving activities. They afford to industrial hygienists an opportunity to work for the best physical development of the workers for whose health they are responsible.

*All these measures contribute to that most important means of health protection, preventive treatment of incipient disease.* Through health surveys the presence of incipient disease may be discovered. The inculcation of health principles through instruction and education helps bring to the worker a realization of the value of prompt action and the importance of early diagnosis of serious conditions. The industrial clinic is the organ through which instruction can be imparted, examinations can be given, and, when a serious condition is recognized, adequate and appropriate treatment can be provided.

Preventive treatment may arrest the progress of incipient disease and thus avert the serious consequences to which neglect inevitably leads. The homely adage, "An ounce of prevention is worth a pound of cure" finds its appropriate application here. The possibility of applying this treatment depends, of course, upon early diagnosis, upon the availability of means for treatment, including, for example, sanitarium care in case of tuberculosis, and upon willingness on the part of the patient to use the measures necessary for his cure.

In addition to a comprehensive program of measures for pro-

tecting the health of the industrial worker, there is need for evidence to show the value of such measures, to appraise specific methods, and to throw light upon which of alternative policies is to be preferred.

*Adequate tests of methods and results must be developed.* The test of the prevention program as a whole must be found in the trend of sickness and death rates and in changes in the prevalence of ill-health. This obviously requires an adequate analysis, based upon sound methods, of statistics of sickness, of death, and of exposure. The effectiveness of the methods in use can be determined only by means of statistical analyses directed toward furnishing specific answers to questions relating to the results of each method. Tests should be developed also to indicate the relative value of different methods, since the object sought is to reach the goal of health by the most efficient method. Efficiency in relation to cost is likewise a primary object of inquiry.

Tests of efficiency should be applied both to technical medical methods and courses of treatment, and also, with due regard to costs, to the elements in the program of industrial hygiene—the periodical health examination, the provision of gymnasium facilities, the industrial clinic, and preventive treatment. Each major policy should be subjected to adequate tests to determine its contribution to health protection.

### III. ALLEVIATION AND INSURANCE

The third group of problems concerning sickness and ill-health has to do with alleviating the burden of wage losses and extra expenses that fall upon sick workers and their families and with distributing costs through insurance.

*Alleviation is most needed at the points where the amounts and burdens of losses are greatest.* These points are shown, of course, by the duration of sickness, its severity, and its consequences. Other things being equal, the longer the sick-

ness the more serious are its consequences for the worker and his family, and the greater is the need for remedial measures. Comprehensive data on the extent of losses and their consequences are needed to aid in determining where measures of alleviation should be applied.

*The forms of alleviation include provision for medical and nursing care and hospital treatment where necessary, or for defraying their cost, and for sick benefits to take the place of wages.* In addition, where ill-health leads to premature death, funeral benefits to defray the extra expenses caused by death, and survivorship benefits to provide for the support of the workers' dependents should be considered as forms of alleviation for the consequences of ill-health.

*The most general, as well as the most satisfactory, method of alleviation is health insurance.* Manifestly, some form of relief is essential. Public or private charity tend to undermine self-respect and the feeling of independence of the recipients. Furthermore, they are not usually made available until the applicants are in distress or extreme poverty. The method of insurance furnishes relief promptly and provides for raising the funds required to defray its cost. This method combines alleviating the burden of economic losses with provision for medical care and with distribution of the costs.

The forms of health insurance are many. Included under this term for present purposes are: trade union sickness benefits, local sick funds, establishment funds, private casualty-company health insurance, group health insurance, and state health insurance. These are included irrespective of whether the workers who are the beneficiaries pay all the cost themselves or whether the cost is defrayed in part by others. Under all these plans the beneficiary has a claim to benefits when he falls sick.

Many questions of policy are raised with respect to health insurance in this broad sense. They include adequacy of benefits, comprehensiveness of scope, voluntary or compul-

sory character, and the apportionment and transfer of costs.

*The question of adequacy of benefits raises the issue whether the insurance system is fulfilling its purpose.* Do the benefits received by sick workers prove adequate to meet medical expenses and take the place of wages? What proportion of wage losses do sick benefits equal? Is sufficient medical treatment provided to restore the sick to health and efficiency as promptly as possible?

In this connection should be considered the question as to what proportion benefits should bear to wage losses. If a worker receives from his sick benefits as much income when sick as he receives in wages when well, he may be tempted to place himself upon the payroll of the sick rather than upon that of the well. This tendency can be combatted by two methods: one is to reduce the proportion of benefits to wage losses so that the incentive to draw sick benefits is less powerful; the other is to supervise closely claims for, and receipts of, sick benefits with a view to eliminating fraud and malingering and to preventing those who are not really sick from claiming and receiving benefits.<sup>9</sup>

*Closely connected with the question of adequate benefits is that of adequate scope of the insurance system as a whole.* A system with adequate benefits in individual cases may fail to reach all workers who are in need of health insurance protection. Is the system sufficiently comprehensive in scope? The scope of each insurance fund depends in part upon its type. Trade union benefits are necessarily limited to trade union members; and not all unions have benefit features. Establishment funds are limited to the employees of the par-

<sup>9</sup> The organization of a system of control is a question of administration; there should be competent medical review of all claims and medical supervision over the drawing of benefits. Wherever such supervision can be supplemented by watchfulness of fellow workers interested in the fund the effectiveness of control is increased.

ticular establishments, and comparatively few have such funds. The extent of insurance through private casualty companies is limited both by its high cost and by the fact that the worker must take the initiative in securing and keeping up payments for such insurance. Even state health insurance provisions may be limited in scope to certain industries or to certain classes of employees and establishments. This variety of possible plans raises for consideration the question whether all workers are protected under some plan, or whether many are left entirely unprotected—in other words, of the adequacy of scope of the insurance system as a whole.

The lack of comprehensiveness in scope of a system based upon different types of voluntary insurance raises the question: should health insurance be compulsory, and, if so, to what groups of workers and to what industries should the compulsory plan be applied? A proposal for compulsory health insurance brings up the problems of how it is to be enforced and of how the sums required are to be collected, besides other important problems of administration.<sup>10</sup>

Correct determination of the cost of health insurance is fundamental to its successful operation. The calculation of premiums and reserves to anticipate correctly the costs of benefits requires data in regard to the incidence of sickness, its duration, and the amount of benefits. Mistakes in the calculation of premiums that result, for example, in rates too low to defray actual costs of operation may lead to bankruptcy of the funds, to failure to pay benefits to those who were expecting that their claims would be met, and to the discrediting of health insurance plans. Errors in the calculation of premiums that lead to too high rates, on the other hand, may discourage

<sup>10</sup> Though such problems should be mentioned for the sake of completeness of exposition, yet in a practical statistical program they have place only when a plan of compulsory health insurance has been introduced or when data are required for the discussion of concrete proposals.

those who might otherwise be induced to take out such insurance.

Costs of administration, also, are important items to be taken into account in fixing health insurance premiums. These costs, which include the cost of writing insurance, of collecting premiums, and of supervising claims for benefits, use up a considerable, and sometimes a large, proportion of the premium receipts. Their amounts should be accurately determined, because the ratio of cost of administration to benefits paid in public, as compared with private, insurance plans is an important point to be considered in deciding whether the state should provide compulsory health insurance.

Another important issue to be decided is: how are the costs of insurance to be defrayed? This may be determined by the form of insurance protection (in the broadest sense) provided, and by the type of administrative agency. Thus, a scheme of trade union benefits obviously draws all its funds from members of the union. Establishment funds are supported largely, if not wholly, by employers, although some plans provide for contributions by workers. Private health insurance costs are paid for wholly by those who take out the insurance. State health insurance may include a contribution by the state for administrative purposes and may provide for an apportionment of the cost between employers and employees. If the system of voluntary private insurance proves inadequate, is the interest of the state such as to justify its assuming part of the cost? Are the interests of the employers such as to justify assessing part of the cost upon them? Would such an assessment tend to promote measures of health protection?

*To decide questions of policy rightly requires the aid of statistics that bear upon the issues.* The adequacy or inadequacy of benefits under existing insurance protection plans is a question of fact upon which statistics, properly prepared, can throw a flood of light. The comprehensiveness of scope

of the insurance system as a whole can be determined only by comprehensive statistics. The point to be emphasized is that statistical data should be utilized to aid in the determination of all issues upon which they furnish relevant information. Decisions should be taken in the light of facts rather than upon the basis of opinion unsupported by evidence.

*Adequate statistical tests of methods and policies, and of plans and agencies, should be available.* Among the most important statistical data are those which test the results of existing arrangements and systems. What proportion of losses do benefits equal? What proportion of the sick receive benefits of any kind? How successful are measures of alleviation or treatment in restoring sick workers to health?

Adequate tests are required also of costs and of methods of administration. Other things being equal, that administration is most successful in which administrative expenses are smallest as compared with the amounts expended for benefits and treatment. Obviously, to make such a test, detailed data on specific items of cost must be available. Data to throw light upon methods of administration of health insurance and sick benefit plans should furnish answers to such questions as the following: Do sick workers receive benefits promptly? Do all those who are entitled to benefits actually receive them? Are the claims settled correctly in the majority of cases? In what proportion of cases are appeals necessary before the worker receives the benefits to which he is entitled? The answers to such questions will throw light upon the success of methods of administering health insurance.

## CHAPTER VII

### STATISTICS NEEDED IN RELATION TO THE WORKERS' HEALTH

The review of the problems connected with the health of industrial workers contained in the preceding chapter leads directly to the development of the statistical requirements for their control. In other words, this chapter is designed to answer in as simple and definite a manner as possible the question: what statistics are required for the purposes already set forth?

At the outset it should be noted that the data required to determine the size of the problem, the prevalence and incidence of sickness, which are useful in awakening public interest and in stimulating remedial action, are also needed in carrying out the actual program of health protection and of lightening and distributing the burden of losses. The discussion of the statistics, therefore, will follow the divisions of proposed remedies, first, health protection, and secondly, alleviation for losses from sickness, and health insurance.<sup>1</sup> The data required for these purposes will serve adequately to define the size and extent of the problems themselves.

Emphasis will be placed, as in the chapter on accident statistics, upon the more immediately practicable data. In the discussion attention will be paid not only to questions of statistical units and to technical problems involved in collect-

<sup>1</sup>The specific statistical requirements with regard to life insurance, survivorship insurance, pensions or annuities, though they fall in part within the field of alleviation for losses suffered in consequence of ill-health of the bread-winner, will not be discussed in the present volume.

ing and interpreting the data, but also to classifications required to make the statistics of the greatest practical use.

### I. FOR HEALTH PROTECTION

The first group of statistics to be considered are those which seem to locate and measure health hazards, to determine causes, to show the responsibility of occupation and industry for disease and death, and to test the results of preventive measures. These obviously show also the size of the problem as a whole and the points where preventive measures should be applied, and throw light upon the measures which can be employed most successfully in prevention. Six types of data are included: those required, (1) to measure physical defects, (2) to determine occupational morbidity, (3) to determine occupational mortality, (4) to locate and measure health hazards, (5) to aid in choosing methods and policies, and (6) to test results.

#### I. To MEASURE PHYSICAL DEFECTS

The data needed concerning physical defects should be based on records of physical examinations made by competent physicians in which all defects that impair the workers' health or efficiency are noted. If these data are to be useful for scientific purposes, care must be taken to have uniform standards of diagnosis and procedure followed by all physicians who participate in the examinations. For practical uses records of such examinations must include all defects that should be taken into account in assigning the worker to his work, that require remedial treatment, or that affect health or efficiency. From the tabulation and analysis of these records the prevalence of defects of each type among workers in each industry can be ascertained.

The data should be classified by type of defect, because without knowledge of the character of the defects they are

valueless. They should be classified further by sex and age, partly in order to show the changes in their prevalence by sex and age, but principally for the reason that, since the incidence of many defects varies with these factors, such a classification is essential if differences in incidence in different establishments and industries are to be correctly appraised. They should be analyzed, further, by occupation and industry in order to throw light upon the relation between different kinds of work and the prevalence of defects. Such statistics should reveal, for example, to what extent persons with serious physical impairment are at work in occupations in which their employment should be prohibited. The data may suggest a causal connection between certain occupations or industries and physical defects. They may indicate also need for special studies to show the influence of defects of specific types upon such points as absence from work, ability to keep jobs, and the kind of positions that can safely be held by persons with certain physical handicaps.

Statistics of physical defects are needed to show the importance of health services as a method of safeguarding the health of workers. They indicate points where definite measures are required to remove defects or to improve health. Wherever the beginnings of serious disease are discovered, they furnish the basis for preventive work. They form a starting point, therefore, for the prolongation of useful life.

## 2. TO DETERMINE OCCUPATIONAL MORBIDITY

Records of sickness among workers in industry should form the basis for statistics of occupational morbidity. The case of illness sufficiently serious to cause absence from work should be taken as the unit for such compilations.<sup>2</sup> Evidence of such

<sup>2</sup> Illness which is of so slight a degree that it does not lead to inability to work should not be classified as a case of sickness though it may form the subject of special studies of the relation of physical condition to efficiency.

illness may be found in the absence itself (in conjunction with a physician's certificate of disability or other approved testimony), or in an approved claim for benefits on account of sickness.

Statistics of occupational morbidity should be as nearly as feasible comprehensive in scope and in any event should be available for enough establishments, industries, and occupations to form a representative sample of the health risks in industry. The data should be of routine character so as to show changes in sickness rates.

Since adequate records of sickness, in practice, are likely to be kept only where special provision is made for the care of the sick or for some form of benefit, satisfaction of the need for adequate records is dependent in part upon recognition of the need for adequate treatment or other provision for sickness. Furthermore, limitations in the scope of medical services and benefits, both in regard to the number of workers covered and to the kinds of illnesses dealt with, are likely to impair the value of the data for any except the administrative needs of the agency which furnishes the benefits.

In addition to statistics of sickness, data on "exposure" to the risk of sickness must be obtained in order to calculate sickness frequency rates on a sound basis. Particular attention must be paid to securing records for "exposure" that represent the groups from which the cases of sickness come. In industrial sickness data, this material partakes of the nature of employment statistics for the establishments to which the sickness data relate.<sup>3</sup>

<sup>3</sup>For comparison with sickness data, man-days rather than man-hours of employment are required, since it would be impossible in most cases to separate the sicknesses which commence during working hours from those which commence outside of working hours. Any attempt to make such a separation would be of doubtful validity, except in case of a specific occupational disease. Irrespective of the time of commencement, for example, a case of tuberculosis or respiratory disease may be of occupational origin. Its cause depends upon the actual

The morbidity record should contain the dates of commencement and termination of sickness, its duration, the duration of absence from work,<sup>4</sup> the cause or disease, the sex and age of the worker, his industry and occupation, and, in addition, information on the kind and character of medical services received—number of visits, surgical and nursing care, appliances and drugs required—and on the outcome, whether death, permanent disability, or recovery.

Cases should be classified according to the nature and duration of the illnesses in order to indicate their gravity and the kind of medical attention required. The data should be classified further according to sex and age to show variations in prevalence of disease in different sex and age groups of the industrial population. Information on the medical services received is important in connection with the extent and cost of medical expenses; while data on the outcome are important in determining both the extent of losses and the results of treatment.

Perhaps the most important classifications to which the data both on sickness and on exposure should be subjected are according to occupation and industry. Such classifications are necessary to show the influence of industry and occupation upon morbidity. The data should be classified also with regard to the cause of disease or the nature of the ailment, since

conditions and circumstances surrounding the worker. On the other hand, in cases of exposure to specific occupational hazard, as in processes of lead manufacture, the hours of direct exposure, as distinguished from the man-days of exposure, might have significance.

<sup>4</sup>The duration of absence from work may not correspond with the duration of disability in cases where "absence from work" in a particular establishment may be terminated by discharge prior to the end of disability; the duration of the benefits may not correspond with the duration of disability in cases where special regulations as to waiting periods, maximum limitations on the length of time benefits are paid, or maximum limits on the amount of benefits cut them off before disability has terminated.

this is of great significance in connection with the responsibility of occupation and industry. And to secure a correct and significant result with respect to the incidence of sickness in different establishments, different occupations, or different localities, the data must be classified also by sex and age in order to avoid fallacies due to the differences in the sex and age composition of the particular groups of workers.

Comprehensive and detailed statistics should be compiled to show the prevalence of each "occupational disease," in the narrow sense of the term, as soon as it can be identified as occupational in character. New processes and new materials are constantly being introduced into industry and hence the number of specific diseases for which occupation is or may be directly responsible is constantly being augmented. Though statistics can be expected only for known and recognized illnesses, yet the data should be gathered on a plan that permits of ready adjustment to include cases of newly discovered diseases.

The data on occupational diseases should be compiled separately from the more general data on sickness, because otherwise cases (often of quite minor numerical importance) of disease due directly to the occupation might be concealed in the mass of general data and would not be appreciated. Furthermore, in many states injuries from certain of these diseases are recognized as compensable under workmen's compensation laws, and hence the collection of statistical data on occupational diseases is important in connection with the adequacy of these laws as well as with their administration.

In addition to data in regard to specific occupational diseases, special studies are needed of diseases which are known to be particularly prevalent in certain occupations or industries. Among such diseases may be mentioned tuberculosis, pneumonia, bronchitis, and silicosis. These studies should seek a fuller and more exhaustive analysis into the exact conditions that influence the prevalence of the par-

ticular disease with a view to discovering the most appropriate methods of reducing its importance and severity.

### 3. TO DETERMINE OCCUPATIONAL MORTALITY

The relation between occupations and mortality can be shown only by comparing comprehensive data on the sex, age, cause of death, and occupation of persons who die within a given period with the sex, age, and occupational distribution of the population exposed to the risk of death. In order to form rates, information must be available both with respect to mortality and with respect to exposure to risk. The data on sex and age are needed to obtain conclusions free from the fallacies and errors that might otherwise result from differences in the sex and age composition of different occupation groups.

The best methods of showing relative mortality in the different occupations are those used in the English statistics of occupational mortality.<sup>5</sup> The actual (male) deaths from 25 to 65 years of age, or over 25 years, in each occupation are compared with the deaths expected from the particular age composition of the group at average rates for the entire (male) population of these ages; this comparison shows whether, and how much, the mortality in the particular occupation falls short of or exceeds the general average.<sup>6</sup>

The principal difficulty, in practice, in compiling occupational mortality statistics lies in the fact that the returns of

<sup>5</sup> *Supplement to the Seventy-Fifth Annual Report of the Registrar-General for England and Wales, Part IV, Mortality of men in certain occupations in the years 1910, 1911, 1912*, pp. i-viii. See also *Supplement to the Sixty-Fifth Annual Report of the Registrar-General, Part II* (Cd. 2619), pp. v-xviii.

<sup>6</sup> An alternative method is to select a standard population of such size that at average rates 1,000 deaths will occur; the number of deaths that would have occurred in this group is then calculated at the rates (at each age) for each occupation. The result gives an index of occupational mortality.

occupation and industry must be derived from two different sources. The data for deaths are taken from death certificates, the information being furnished to the undertaker for entry in the record by relatives of the deceased. The data for population are taken from the census of occupations, the information being gathered by census enumerators. The value of statistics of occupational mortality depends upon the comparability of the data obtained from these two sources; for the deaths must be compared with the total number of persons at risk in each occupation. Even though the death rates or ratios for occupations with vague or general designations, such as laborer, are likely to be subject to wide margins of error, those for occupations which are designated by definite and clear terms should be substantially accurate and of valid significance.

A difficulty in interpreting the results as due to occupational influences arises from the presence of selection. Occupations which require great physical strength are open only to men of good physique and the low mortality experienced may result in part, therefore, from the selection of men in good health for the work. A classification of deaths by causes is helpful in throwing light upon the possible influence of selective factors. The statistics should be classified, therefore, by causes of death; and indexes should be worked up to show the relative mortality in the several occupations from each cause.<sup>7</sup>

#### 4. TO LOCATE AND MEASURE HEALTH HAZARDS

In addition to statistics of defects, sickness, and mortality, which throw light upon the prevalence of health hazards by showing their effects upon sickness and death rates, statistics should be collected, where practicable and where they can be

<sup>7</sup> Cause-of-death classifications have been standardized throughout the United States where the so-called "International list of causes of death" is in use.

utilized, to show the prevalence of specific conditions that are known to involve health hazards. For example, since the manufacture of benzene and its derivatives, and processes which require their use, are recognized as involving risks to health, a public health-protecting agency needs to know how many establishments are engaged in the manufacture or use of this substance and how many employees are subject to its hazards. Data of this type are necessary to show the extent of risks to health which such processes involve. Though to measure the degree of risk connected with each process and to find means of reducing it is, of course, of primary importance, it is likewise essential to know the extent of the exposure and the number of places where measures should be taken to safeguard health.

#### 5. To AID IN CHOOSING METHODS AND POLICIES

The foregoing data should furnish measurements of the problems of ill-health and should show the points where preventive effort is needed. For further light upon the subject statistics of methods in use should be developed to cover the scope and value of existing health-protection activities.

Comprehensive data on the scope of each principal method of protection should be available. Such data should cover at least the following subjects.

The prevalence of health examinations in industry; the proportion of establishments in each industry which require initial or periodical examinations for their employees and the proportion of all employees in each industry employed in such establishments.

The prevalence of establishment or industrial clinics as adjuncts to factories or work places; the proportion of establishments and of employees in each industry that have or enjoy such facilities.

The extent to which preventive treatment is made available; the number and proportion of establishments in each industry

which provide facilities for treatment and the number and proportion of employees who enjoy such benefits.

Data required to measure the success and efficiency of methods of health protection should be obtained through special studies and investigations. The value of such methods should be studied not only from the point of view of industrial enterprises but also from the point of view of their effect in decreasing sickness and in prolonging the lives of workers, as revealed in the general record of changes in sickness and mortality rates.

The details needed will depend upon the nature of the method investigated and are difficult to specify in general terms. For example, statistics to indicate the value, from the point of view of an enterprise, of installing and maintaining an industrial clinic or health department should include not only data on physical defects with a view to indicating decreases in their prevalence but also data on recommendations made as a result of health examinations—prescriptions, recommendations for special consultations, for operations, and for changes of work—and data on their results. How many applicants for work whose health would not permit their safe employment in particular occupations are eliminated through physical examinations? To what extent do the examinations point out remediable defects? How many of these defects are remedied? What relation does the cost of an industrial clinic or health department bear to the value of the results accomplished? Statistics on these points are important not only because they show to the individual employer the value of the industrial clinic in his own establishment but also because they furnish evidence to justify the adoption elsewhere of these methods.

#### 6. To Test Results

The data required to test results and to show the progress of prevention are for the most part, if not wholly, comprised

within those already described. For the purpose of testing progress the comparability of the data from year to year or from period to period is of prime importance. Without comparability the figures are valueless for measuring changes. The statistics needed for tests of progress include not only those relating to the prevalence of physical defects, the incidence of disease, and the trend of occupational mortality, but also data showing increases in facilities for health protection, in the number of industrial and establishment clinics, in the scope of health examinations, in provision for and use of recreation and gymnasium facilities, and in attention to preventive treatment.

## II. FOR ALLEVIATION AND HEALTH INSURANCE

The second group of statistics to be considered, those required to aid in alleviating and distributing burdens due to the ill-health of workers, includes four different types of data: those needed, (1) to locate and measure losses, (2) to test measures and results, (3) to determine and distribute costs, and (4) to aid in determining methods and policies.

### i. To Locate and Measure Losses

The statistics required to locate and measure losses from sickness and need for alleviation include the following data:

i. Statistics on the basis of which wage losses suffered by different occupational and industrial groups in different states or areas can be estimated. The data required are in part the same as those needed to measure the prevalence and duration of disability caused by sickness. For each case of sickness the duration of disability (sufficient to cause absence from work) and the average daily or weekly earnings of the sick person should be available.<sup>8</sup> The product of the average

<sup>8</sup>The information on wages should include data sufficient to furnish a basis for determining for statistical purposes the normal average

weekly earnings by the total number of weeks of disability gives the wage loss caused by sickness. Data should be available to show not only the total wage losses for all workers but also the classified amounts of wage losses suffered by individual workers.

An estimate of the wages lost on account of premature death involves greater difficulties. To estimate the time lost requires, first, estimates, based upon the judgment of physicians, of the possible saving in mortality through the application of medical knowledge. With the aid of these estimates the total time which could be added to working life by such application of medical knowledge could be calculated. Wage losses can then be estimated, for practical purposes, as in the case of sickness, by multiplying average wages by the estimated time lost.

2. Statistics to show the losses caused by sickness in the form of cost of medical attention of all kinds. Data on the total costs of all kinds of medical, surgical, and nursing care, whether paid by employer, by employee, or by the public, should be available for each case of sickness. The statistics should show the total costs and the classified amounts of costs for each type of case.

As a measurement of the total losses, however, the cost of medical attention is unsatisfactory since it makes no allowance for cases in which no medical care was received or in which the care was inadequate. On the assumption that failure to receive adequate medical attention involves losses at least equivalent to the difference in cost between the care received and the care which would have been adequate, the total losses in such cases might be estimated on the basis of the cost of adequate care, or of the care given in the best plants. If

weekly earnings. If the actual earnings during the week or month prior to the commencement of disability for one reason or another were abnormal, enough information should be obtained to show what the normal earnings were during a significant period of time.

the medical service provided in certain plants is adequate, the data on costs in typical cases in such plants may be used as a basis for determining standard unit costs. Multiplying these by the number of cases of each type will yield a figure for the cost of adequate medical services which will serve as a measure for the total losses of this type incurred because of sickness.

## 2. TO TEST MEASURES AND RESULTS

In testing measures and results the chief points to be considered are the scope and adequacy of alleviation and the efficiency shown in administering the various types of sick benefit systems.

Statistics needed to show the scope of each method of alleviating the burden of losses include:

1. The number of cases of sickness for which benefits, of any kind, were claimed and paid, and the number of cases for which no benefits were received.

2. The number and proportion of workers who are protected by each of the various methods—trade union benefits, establishment funds, and health insurance—and the number and proportion of workers who are unprotected.

Perhaps the most important question raised in regard to methods of alleviation relates to the adequacy of benefits. To test this statistics on the following points are required:

1. The amounts received as benefits compared with wage losses. The comparison should show not only the proportion that the benefits form of wage losses in totals but also in individual cases classified by types. These should be sub-classified according to the type of benefit fund or health insurance plan so as to show the adequacy or inadequacy of alleviation provided under each method, and the value of each in meeting the problem.

2. Medical benefits received compared with medical benefits required for adequate care. In addition to the data men-

tioned previously (see p. 147), light upon this point can be thrown by the following data: (a) statistics of the cost of care for which the worker is forced to provide would be valuable, though probably they are unobtainable; (b) data on the prevalence of inadequate medical services would be significant, for example, statistics of cases where no medical attention of any kind was received, analyzed by the type of case; (c) studies of the work of industrial health departments by experts in appraising the value of such services would yield data on the adequacy of these establishment arrangements for health protection; (d) studies of the duration of sickness of certain types, in conjunction with the amount and character of medical attention, would be valuable.

3. Data by which the adequacy of alleviation can be judged objectively, such as statistics of the number of cases where destitution caused by sickness resulted in appeals for poor relief or charity, or where, though benefits were received, they did not suffice to avert the need for special relief.

Statistics to test the efficiency of administration of sick benefit measures should include at least the following:

1. The average length of time elapsing between the commencement of sickness, or the filing of the claim for benefit, and the receipt of the award. This should answer the question whether the time required for deciding the merits of claims is excessive.

2. Data relating to the control exercised over receipt of health benefits, the medical supervision over each case, the number of examinations made by physicians, the number and proportion of fraudulent claims, the number and proportion of cases of malingering, and the number and proportion of cases in which benefits are drawn after recovery.

### 3. TO DETERMINE AND DISTRIBUTE COSTS

The determination of costs and their distribution through premium rates require statistics of the incidence and duration

of sickness, the benefits for each type of case, and costs of administration. To ascertain the net premium cost of sickness its incidence and duration should be determined, so far as possible, for the particular group of insured persons. The presence of elements of selection in the different groups may vitally affect the incidence of sickness. The "moral hazard" is also a factor of which account must be taken.

Because of the influence of selection, of different "moral hazards," or of different bases for drawing benefits, it is difficult to utilize the experience of a casualty insurance company to estimate the probable experience of an establishment fund or of a comprehensive health insurance scheme. Each group or fund is likely to be forced to rely to a large extent upon its own experience in calculating its premium rates or costs. Nevertheless, the compilation from comprehensive experience of a general sickness rate should provide a more satisfactory basis for determining the incidence and duration of sickness, and the costs of sickness benefits, than the limited experience of any single group alone could furnish.

In addition to data for determining the net premium cost of health insurance, statistics on administrative expenses are required. The elements in such expenses are the cost of obtaining business, the cost of medical supervision over claims, and the cost of health protection work, as well as the purely administrative items of paying claims and of ordinary overhead expenses. Data showing the total amounts of these costs and their amounts classified according to major elements should be available.

#### 4. To AID IN DETERMINING METHODS AND POLICIES

All the statistics described in the preceding section are useful in choosing methods and policies. In particular, the data needed to test the working of the present system of alleviation and to show its shortcomings are of especial value because

they indicate where changes are necessary to increase the efficiency or to improve the quality of measures of alleviation.

Perhaps the most important question relating to the choice of methods and policies is that of state compulsory *versus* private voluntary insurance. Pertinent to this question are the data that show the adequacy or inadequacy of the existing system of private insurance of all kinds and the adequacy or inadequacy of sick benefits provided under this system. Of special value would be comparative studies of the relative efficiency of private as compared with state insurance in other countries. Data on costs, particularly on administrative expenses, are also necessary. In short, data that throw light upon all the essential issues, whether relating to benefits or to costs, are appropriate for the decision of policies. Not only should data on the existing inadequacies be assembled, but also data on the effects of increasing the adequacy of benefits upon the "moral hazard"—malingering, simulation of sickness, and prolongation of cures. Not only should cost data cover the relative cost of adequate as compared with inadequate benefits, but also the relative cost of private and state administration, and the possibilities of meeting the cost by assessments upon workers, employers, and the public. Data should be gathered also to show the effects of these burdens upon the family budgets of workers, the competitive position of establishments and industries, and the public treasury.

Finally, data should be available to throw light on the effect of adequate benefits upon the welfare of the industrial population. To what extent will provision for sick benefits and medical care lessen the prevalence and incidence of sickness? Is this effect increased by levying a portion of the cost upon industry? Would industrial and establishment plans for adequate medical supervision and care of the health of employees be stimulated by compulsory health insurance, or are they sufficiently justified by the gains which accrue from cutting down absences, and improving efficiency as a result of

raising the level of health among employees? Further, data should be collected to show the effect of eliminating wage losses and medical expenses on account of sickness as a cause of poverty and distress. A comparison of the numbers and proportions of cases seeking relief on account of sickness before and after the introduction of a plan of adequate benefits for sickness would afford valuable evidence with regard to the effect of adequate health insurance upon the welfare of workers and their families.

## CHAPTER VIII

### APPRAISAL OF EXISTING STATISTICS RELATING TO HEALTH PROTECTION AND TO HEALTH INSURANCE

The task of appraising existing statistics in the fields of health protection and insurance appears the simpler because of their relatively limited development. Upon few, if any, subjects comprised within the scope of the present discussion are comprehensive statistics available for the United States. We have no data of comprehensive and routine character that define the risk of sickness to workers by occupations or industries. Nevertheless, special studies or surveys are available that constitute pioneer attempts to give a picture of the physical condition of larger or smaller groups of the working population. Even though these studies and surveys are limited in scope, they must be carefully considered, not only because they contain the promise of future developments, but also because the experience in surmounting difficulties gained in the course of collecting and analyzing their data should prove of great value in drawing the outlines of a future program. As in the case of accident statistics, however, only published data are here considered.

#### I. HEALTH PROTECTION

Existing statistics relating to health protection will be discussed under six heads, physical defects, sickness, occupational mortality, occupational health hazards, methods of health protection, and tests of progress.

## I. PHYSICAL DEFECTS

In the field of physical defects, as distinguished from illness causing disability and absence from work, the available data belong to two groups: first, the results of physical examinations of workers; and second, data obtained in more or less general surveys or censuses that throw light upon the prevalence of defects among the industrial or wage-earning population.

Records of physical examinations of wage-earners form the basic material for statistics of the first group. The examinations are sometimes limited to workers employed in a particular industrial establishment, and sometimes to workers belonging to a particular union or engaged in a particular occupation or industry.

Many large industrial concerns require physical examinations of workers on their entrance into employment or periodically while employed.<sup>1</sup> Railroad companies, for example, have long required physical examinations of engineers and firemen, who are placed in responsible positions. The records of such examinations constitute raw materials for valuable statistical analyses. Unfortunately, for the most part such analyses have not been made or, if made, have not been published. In some cases the records have not been properly kept; in others the examinations have not been standardized; and in still others the value of publication has not appeared to the companies sufficient to justify the expense. In certain cases, however, data based on these records have been utilized to throw light upon the prevalence of specific types of defects and upon the value of physical examinations of workers. Even though the procedures and standards of diagnosis may vary

<sup>1</sup> See, for examples, Mock, Harry E., M.D., *Industrial Medicine and Surgery*, pp. 86-89.

from plant to plant, these data are valuable because they indicate at least a minimum prevalence of defects.<sup>2</sup>

Records of physical examinations of workers employed in particular occupations or industries are available in some cases as a result of special investigations, and in others as a result of provision for examinations made by unions for their membership. Studies of bakers, printers, and other groups for purposes of health protection have been made by the public health authorities, by unions, and by groups interested in social welfare. In New York City certain locals of the Garment Workers' Union and of the printers' union provide for physical examinations of all applicants for membership. This requirement grew out of the granting of sick benefits to members, which led to a desire to exclude "bad risks" from admission in order to exclude them from being entitled to claim benefits from the fund on account of prolonged disability. But it represents also an effort on the part of the union to make available to its membership the advantages of health supervision. Studies of the results of these examinations are available in the case of the garment workers.<sup>3</sup> From time to time, also, special studies of the physical condition of workers in specific occupations have been published by the Public Health Service, by the Bureau of Labor Statistics, and by state organizations.<sup>4</sup>

<sup>2</sup> For an example of the results of such a survey, see Clark W. Irving, Jr., M.D., "Heart Disease in Industry," *Boston Medical and Surgical Journal*, July 6, 1922, Vol. 187, pp. 21-23.

<sup>3</sup> Schereschewsky, J. W., *The Health of Garment Workers*, Part I of Studies in Vocational Diseases, Public Health Bulletin No. 71, May, 1925.

<sup>4</sup> See Price, George M., "Occupational Diseases and the Physical Examination of Workers," *Transactions of the Fifteenth International Congress on Hygiene and Demography*, Washington, September 23-28, 1912, Vol. III, Part II, pp. 844-849, especially p. 845.

Bulletins of the Bureau of Labor Statistics, Series on Industrial Accidents and Hygiene.

See also Public Health Bulletins, Nos. 71 and 116.

Considered from the point of view of the requirements, however, the material based on physical examinations of workers is decidedly fragmentary in character. Its scope is limited; only the larger and more progressive establishments keep such records, and but few unions require physical examinations for membership. Comparatively little even of the existing data has been utilized in statistical analysis or, if so utilized, has been made available. The analyses which have been published emphasize the general prevalence of defects rather than the aspects of the data that might throw light upon the effects of specific occupations. The existing data, in any case, are not comparable as between different establishments or different types of material, because the examination, diagnosis, procedure, and records are unstandardized.<sup>5</sup>

Data belonging to the second group, although less closely related to the problem under consideration, the prevalence of defects among workers in particular industries and occupations, throw light upon the prevalence of defects among wage-earners in general. One type of study is exemplified in the analysis of records of physical examinations made by the Life Extension Institute, according to a standardized procedure, of policy holders in the Metropolitan Life Insurance Company.<sup>6</sup>

A second type is exemplified in censuses of disabling defects in a population. To this type belong the studies of the prevalence of disabling defects and sickness made by the Metropolitan Life Insurance Company among wage earners carry-

<sup>5</sup> Color blindness, for example, is a defect which can be tested easily in an examination, and is one which is of great importance in case of locomotive drivers. But a study which shows no cases of color blindness in a group of workers may mean merely that the procedure of testing for this defect was not included in the particular examinations that formed the basis of the report.

<sup>6</sup> Hackett, J. D., *Health Maintenance in Industry*, pp. 28-29, 208-210; also, Dublin, Louis I., Fisk, F. L., and Kopf, E. W., "Physical Defects as Revealed by Periodical Health Examinations," *The American Journal of the Medical Sciences*, October, 1925, Vol. 170, pp. 576-594.

ing industrial life insurance and their families in certain cities.<sup>7</sup> These studies were not related to occupations or industries.

Mention may be made also of the comprehensive survey of physical defects among men of draft ages, 21 to 30 years inclusive, contained in the records of the physical examinations of over two million men examined for army service in 1917 and 1918.<sup>8</sup> The men examined were practically all engaged in some occupation, and hence the records give a broad survey of defects among workers in this particular age group. The data were not related, however, to the occupations in which the men had been engaged. The defects observed were regarded solely from the viewpoint of their importance for army service. Furthermore, the absence of uniform specifications and directions for the examinations and the fact that examinations were made by two different groups—by local boards, which operated without special rules and often without keeping adequate records, and by army physicians in the various camps, who had more rigorous standards—tend to impair the value of the results.<sup>9</sup>

In summary, existing data on the prevalence of physical defects in relation to occupation and industry are as yet far

<sup>7</sup>The results of these studies are summarized in Hackett, J. D., *Health Maintenance in Industry*, p. 23.

<sup>8</sup>Love, Albert G., M.D., and Davenport, Charles B., *Defects Found in Drafted Men*, U. S. Surgeon General's Office, 1920.

<sup>9</sup>More comprehensive in plan, though more remote in time, less closely applicable to the occupied population, and much less satisfactory in execution, were the general surveys of disabling sickness and physical defects taken in connection with the censuses of 1880 and 1890. The results were published for only certain states and localities and even for these were admitted to be incomplete. See Billings, John S., *Report on the Mortality and Vital Statistics of the United States as Returned at the Tenth Census (June 1, 1880)*, Part II, pp. cxxxvi to cxxxix, U. S. Census Office; also Billings, John S., M.D., *Report on Vital and Social Statistics in the United States at the Eleventh Census, 1890*, Part I, pp. 474-480, U. S. Census Office.

from comprehensive. The available data represent but the crude beginnings of an adequate statistical survey. They cover only scattered establishments or scattered groups. They are meagre in detail and suffer from lack of standardization in procedure and diagnosis.

## 2. SICKNESS

Two types of data on sickness are available, those that indicate the proportion of persons disabled by sickness at a given time and those that indicate the incidence of cases of sickness over a period—the sickness rate. In the second type of statistics the duration of disability is commonly obtained as well as the rate of sickness.

The prevalence of disability caused by sickness is usually included in censuses of disabling defects and diseases, as described in the preceding section. Such censuses cover usually sickness among unemployed as well as among employed and in some cases among the families of wage-earners as well as among the wage-earners themselves.

Surveys of this type, that indicate the prevalence of sickness at a given time, are available for a few limited areas only. Among them may be mentioned the surveys made by the Metropolitan Life Insurance Company of the wage-earning population in selected cities.<sup>10</sup> The investigations into the prevalence of sickness made by the Health Insurance Commission of Illinois also belong in this category.<sup>11</sup>

The results of a single census of sickness will depend upon the time of year when it is made, but this difficulty is avoided in certain studies by repeated canvasses made at different seasons. This method is used, for example, in a study made

<sup>10</sup> See above, note 7, p. 172.

<sup>11</sup> Burgess, Ernest W., "A Study of Wage-earning Families in Chicago," Special Report I, *Report of the Health Insurance Commission of the State of Illinois, May 1, 1919*, pp. 179-317.

by the Public Health Service of the incidence of disabling sickness in cotton-mill communities.<sup>12</sup>

Such surveys have the merit of including all persons in the particular group, and avoid the criticism that sickness studies commonly relate to the well and lose sight of those who are chronically ill or permanently disabled. On the other hand, although the two last mentioned take into account various factors in the incidence of sickness, such surveys do not lend themselves, for the most part, to detailed analyses.

For most purposes the rate or incidence of sickness is the most valuable index of health. Data of this second type fall into two groups, data collected directly to show the sickness rate and data which, though collected for some other purpose—usually for a record of sick benefit payments—indirectly indicate the prevalence of sickness.

In the first group are included analyses of records of absences kept by establishments to show the incidence of sickness and its importance as a factor in causing lost time. In all such studies difficulties are found not only in defining absence, for example in cases of discharge or voluntary withdrawal of a person who is sick, but also in ascertaining the fact of sickness as the reason for absence when the employee does not report it on return to work or does not return to work at all. Furthermore, if the cause of sickness is not certified by a physician the data on causes are of little value.

Comparatively little material of this type is available.<sup>13</sup>

<sup>12</sup> Wiehl, Dorothy, and Sydenstricker, Edgar, "Disabling Sickness in Cotton Mill Communities of South Carolina in 1917, A Study of Sickness Prevalence and Absenteeism, as recorded in repeated canvasses, in relation to seasonal variation, duration, sex, age, and family income," *Public Health Reports*, Reprint No. 929, June 13, 1924, Vol. 39, pp. 1417-1443.

<sup>13</sup> In this category might be placed, perhaps, the records of absence on account of sickness of government employees kept by the various offices of the Federal government. The fact that application for sick leave with pay is necessary to obtain the privilege tends to

Although all establishments keep a record of the hours and days worked by each employee for payroll purposes, few attempt to secure data relating to reasons for absence or, if they do secure such data, to analyze them for absences due to sickness.<sup>14</sup> Perhaps this is due to the tendency for employers who are interested in the causes and prevalence of sickness to establish sick benefit funds, the records of which—usually more complete in regard to these points—take the place of similar records kept directly by the employers themselves.

The second group of data showing the rate or incidence of sickness includes data on sickness benefits which indirectly show its prevalence. Records relating to the frequency and duration of sickness are by-products of the administration of sick benefit funds of the different forms, including establishment, trade union, and local funds, and voluntary and compulsory health insurance.

Obviously, sickness data of this type are limited by the scope of the benefit fund system.<sup>15</sup> Even within these limits, however, the available statistical material is further restricted because of the fact that most of the records are either not in shape to tabulate or are not utilized. Nevertheless, the Public Health Service has recently secured the co-operation of a number of such funds and has made statistical analyses of the data contained in copies of their records. Summaries of the results are published from time to time in *Public Health Reports*.<sup>16</sup>

make these records more complete. On the other hand, the fact that the leave is granted for only a limited period (usually 30 days) is likely to affect the results so far as duration is concerned.

<sup>14</sup> In some cases the duration and the cause of absence are placed upon punched cards for purposes of tabulation and analysis.

<sup>15</sup> See below, pp. 176-7.

<sup>16</sup> "Sickness among Industrial Employees," *Public Health Reports*, January 22, 1926, Volume 41, pp. 113-131. Also, "Frequency of Disabling Illnesses among Industrial Employees, Incidence of Illnesses from Important Causes Lasting Longer than One Week among 100,000 Per-

Even less use has been made of the sickness records of workers' benefit associations than of those of industrial or plant benefit funds. As an example of the possibilities of such material mention should be made of a study by the U. S. Bureau of Labor Statistics of disability among over 40,000 wage earners insured in the Workmen's Sick and Death Benefit Fund of the United States of America, in which disability rates were analyzed both by age and by occupation.<sup>17</sup>

Practically no use has been made of the sickness data from union benefit funds. In many, if not in most cases, these funds are operated by local unions. For the most part the records have never been analyzed statistically. Furthermore, in a considerable proportion of cases, changes in the form of records would doubtless be needed to make them useful in any general compilation of sickness data.

Data from health insurance experience are available, of course, to the insurance companies, which utilize them in making and checking up their rates.

In all these cases, however, where statistics are available the value of the data is limited by the character of the fund. The type of membership, the character of the experience, and the conditions for drawing benefits, all vary with the kind of fund. Union benefit funds are limited to the members of unions, establishment funds to persons employed in the establishments, and insurance company experience to persons willing

sons in 1923, and a Summary of the Experience for 1920-1923," *Public Health Reports*, Oct. 31, 1924, Volume 39, pp. 2721-2730. See also Sydenstricker, Edgar, and Brundage, Dean K., "Industrial Establishment Disability Records as a Source of Morbidity Statistics," *Quarterly Publications of the American Statistical Association*, March, 1921, Vol. 17, pp. 584-598; and Brundage, Dean K., "Statistical Analysis of Sick Benefit Association Records," *Proceedings of the National Safety Council*, Thirteenth Annual Safety Congress, held at . . . Louisville, Kentucky, 1924, pp. 418-428.

<sup>17</sup> Emmet, Boris, "Disability among Wage Earners," *Monthly Labor Review*, November, 1919, Vol. IX, pp. 1322-1341.

and able to take out health insurance. All these groups are subject to special types of selection and, as a result, the data secured from one type of experience may not yield the same results as those secured from other types. So far as conditions governing the granting of benefits are concerned, payment of benefits for the waiting period in cases where the duration of sickness exceeds a stated time is likely to be reflected in a larger proportion of cases which equal or exceed this duration. The kind of supervision over the granting of claims and the drawing of benefits also has an influence over the frequency and duration of sickness as experienced by the fund.<sup>18</sup>

Statistics based upon the records of compulsory health insurance systems avoid these difficulties. For this reason, the sickness statistics of England and Germany, which are based upon experience under the comprehensive health insurance systems in force in these countries, are particularly valuable.<sup>19</sup> But foreign data are not, of course, applicable to American industrial conditions.

The general statistics of industrial morbidity for the United States, it should be said in summary, are in an early stage of development. Records of sickness relate principally to groups covered by sick benefit provisions of some kind. When these records are analyzed for publication exposure is usually taken into account and morbidity rates are usually given; in many cases the data are analyzed by sex and age. With few exceptions no classification is made by industries or occupa-

<sup>18</sup> Other points are discussed by Brundage, Dean K., "Statistical Analysis of Sick Benefit Association Records," *Proceedings of the National Safety Council, Thirteenth Annual Safety Congress, 1924*, pp. 418-428. See also reference to Rusher in Note 19.

<sup>19</sup> See Rusher, Edward A., "The Statistics of Industrial Morbidity in Great Britain," *Journal of the Royal Statistical Society*, January, 1922, Vol. LXXXV, pp. 27-71, especially pp. 60-71. See also the special analysis of the sickness data of the Leipzig sick fund, *Krankheits- und Sterblichkeitsverhältnisse in der Ortskrankenkasse für Leipzig und Umgegend*.

tions, though in some cases all the members of the groups for which figures are given are employed in particular industries or occupations. For the most part, the available data are not sufficiently large in volume to permit of such analysis.<sup>20</sup> The difficulties in the way of amassing original records of a satisfactory character are great, and the primary analyses by cause, sex, and age must be carried out in detail. Hence, an exceptionally large volume of data is required if sound conclusions are to be derived from a further analysis by occupation and industry. The meagre data available, therefore, are of very limited scope and value.

Of an essentially different character are the data on specific "occupational diseases," using the term in the narrow sense, which are derived from cases reported, from claims for compensation presented, and from awards made under provisions

<sup>20</sup> Other sources of information in regard to the prevalence of sickness are of limited usefulness. Reports of contagious diseases to health officers in towns and cities are imperfect in execution and limited in application. For the most part the occupational diseases, so called (except anthrax), are not notifiable.

Hospital records are of little value in determining the prevalence of sickness because it is practically impossible to ascertain the number of persons exposed to risk with which to compare the cases of disease. They are chiefly useful in studies to determine the value of methods of treatment.

Records of general industrial disease clinics (as distinguished from establishment clinics), like those of hospitals, are of little value in measuring the incidence of sickness among workers in industry. They are especially useful in the study of specific occupational diseases.

Records kept by individual physicians are practically useless for general statistical purposes not only because exposure cannot be ascertained, but also because they are dependent upon the individual physician for analysis and publication. The records kept by one physician are not readily amenable to combination with those kept by others because of differences in methods and standards of diagnosis among physicians, and even those of a single physician are likely to be affected by changes in methods which are constantly taking place. The usefulness of physicians' records is greatest in connection with monographs on specific diseases and modes of treatment.

of workmen's compensation laws. In practice the records on this subject are limited to the states (10 in number)<sup>21</sup> in which occupational diseases are covered by provisions of the compensation law and in which reports of such diseases are required. Only seven of these states publish even the most meagre data on occupational diseases, and their reports cover in most cases only specified lists of illnesses. Furthermore, the figures relate to cases of sickness only; corresponding data on exposure are available only in so far as they are available for accidents also. The data available must be characterized, therefore, as fragmentary.

Another type of statistical study that throws light upon the relation between occupational conditions and health is based upon intensive analysis of the causative factors concerned in specific diseases, such as tuberculosis, anthrax, lead poisoning, and tetraethyl lead. A number of studies of this type have been published by the Public Health Service and the Bureau of Labor Statistics.<sup>22</sup>

<sup>21</sup> Territories and dependencies are here omitted in the list of "States." See Andrews, John B., "Occupational Disease Compensation," *Proceedings of the Eleventh Annual Convention of the Association of Governmental Labor Officials of the United States and Canada*, held at Chicago, May 19-23, 1924, U. S. Bureau of Labor Statistics, Bulletin No. 389 (1925), pp. 42-46.

<sup>22</sup> Among these may be cited: Robinson, D. E., and Wilson, J. G., *Tuberculosis among Industrial Workers*, Public Health Bulletin No. 73, 1916.

*Proceedings of a Conference to Determine whether or not there is a Public Health Question in the Manufacture, Distribution or Use of Tetraethyl Lead Gasoline*, Public Health Bulletin No. 158, August, 1925.

Hamilton, Alice, M.D., "Dope Poisoning in the Making of Airplanes," *Monthly Labor Review*, February, 1918, Vol. VI, pp. 289-316.

Hayhurst, Emery R., "Why Industrial Health Is a Tuberculosis Problem," *National Tuberculosis Association, Transactions of Twenty-first Annual Meeting*, 1925, pp. 434-441.

Andrews, John B., *Anthrax as an Occupational Disease*, U. S. Bureau of Labor Statistics, Bulletin No. 267, July, 1920.

See also other bulletins of the series, "Industrial Accidents and Hygiene," issued by the U. S. Bureau of Labor Statistics.

### 3. OCCUPATIONAL MORTALITY

The only significant data on occupational mortality of a general character for the United States are statistics for 1890 for the Death Registration Area, in which deaths (of males) were compared to exposure for broad occupation groups as well as for certain specific occupations, due attention being paid to differences in age composition.<sup>23</sup> However, some doubt may attach to the exact comparability of the occupational returns of the population with those of deceased persons.

For general comparison between the mortality rates in different occupations for later dates the only recourse is to foreign statistics, in particular to the excellent English occupational mortality data.<sup>24</sup> The applicability of this material in its entirety to occupational conditions in this country is, however, open to question.

In addition to this material of a general character, special studies of mortality in particular occupations have been made, for example, for engineers and firemen, and for physicians.<sup>25</sup>

<sup>23</sup> Billings, John S., M.D., *Report on Vital and Social Statistics in the United States at the Eleventh Census, 1890*, Part I, pp. 61-194. In the same report the analysis of "proportionate mortalities," by causes, for states outside the registration area was of no significant value.

<sup>24</sup> See references given in note 5, p. 171.

<sup>25</sup> See Emerson, Haven, M.D., "Death Rates of Male White Physicians in the United States, by Age and Cause," *American Journal of Public Health*, November, 1926, pp. 1088-1093.

"Longevity of Locomotive Engineers, 1912 and 1922," *Statistical Bulletin*, Metropolitan Life Insurance Co., December, 1923, Vol. IV, No. 12, pp. 5-7.

Mention should be made also of an analysis of the occupational mortality experience of the Metropolitan Life Insurance Company Industrial Department by causes of death; unfortunately no corresponding data on exposure were available. See Dublin, Louis I., *Causes of Deaths by Occupation*, U. S. Bureau of Labor Statistics, Bulletin No. 207, and "Occupational Mortality Experience of 94,269 Industrial Workers, Metropolitan Life Insurance Company, 1911-13," *American Journal of Public Health*, July, 1916, Vol. VI, pp. 663-670.

## 4. OCCUPATIONAL HEALTH HAZARDS

Few statistical surveys have been made of the extent of occupational health hazards. Such surveys are sometimes based upon the number and character of hazards, sometimes upon the number of establishments, and sometimes upon the number of workers affected. Probably the most comprehensive survey of this type is that made by Doctor Hayhurst covering industrial health hazards in Ohio.<sup>26</sup>

## 5. METHODS OF HEALTH PROTECTION

No comprehensive statistics are available to show the extent to which industry has adopted specific methods of health protection, such as the industrial clinic, the staff physician, or the routine health examination of all employees. Pioneer studies of selected plants throw light, however, upon these points. Among such studies should be mentioned a survey of 155 establishments in the Eastern and Middle Western states made by the Public Health Service in 1918,<sup>27</sup> studies of the National Industrial Conference Board,<sup>28</sup> and state surveys in Pennsylvania and Wisconsin.<sup>29</sup>

<sup>26</sup> Hayhurst, E. R., *A Survey of Industrial Health-Hazards and Occupational Diseases in Ohio*, February, 1915, *passim*, especially pp. 117 and ff.

See also Lauck, W. Jett, and Sydenstricker, Edgar, *Conditions of Labor in American Industries, A Summarization of the Results of Recent Investigations*, pp. 324-325.

Warren, B. S., and Sydenstricker, Edgar, *Health Insurance: Its Relation to the Public Health*, Public Health Bulletin No. 76, pp. 8-14.

<sup>27</sup> Selby, C. D., *Studies of the Medical and Surgical Care of Industrial Workers*, Public Health Bulletin No. 99, 1919, p. 5.

<sup>28</sup> *Health Service in Industry*, National Industrial Conference Board, Research Report No. 34, Jan., 1921.

Rector, Frank L., "Physical Examinations in Industry," *Monthly Labor Review*, April, 1926, Vol. 22, pp. 770-771.

<sup>29</sup> *Bulletin of Information*, Industrial Board, Department of Labor and Industry, Pennsylvania, March, 1923, pp. 2-3.

Statistics in regard to the value of these methods are likewise meagre. For the most part, references to this question call attention to data that bear upon the profitableness of specific measures.<sup>30</sup> For example, data on the proportion of applicants for employment who were rejected on account of defects discovered by physical examinations are used to show the saving in labor turn-over for which these examinations are responsible. Statistics of defects ascertained and remedied through industrial health protection work are useful in indicating improvements in health resulting from the introduction of such work. Systematic studies of this type, however, are not available.

#### 6. TESTS OF PROGRESS

Knowledge of the progress of sickness prevention and health protection suffers from the almost complete absence of all fundamental data necessary for measuring changes. In view of the lack of statistics to show the prevalence of sickness in given occupations at a given time, there is as yet no direct evidence for determining whether its prevalence is increasing or decreasing. But even if adequate data were available, the difficulties in the way of insuring comparability would have to be surmounted before valuable and sound conclusions could be drawn. From another point of view, statistics to show the spread of measures for the protection of employees, for example, and the spread of industrial clinics, of plant medical services, and of health supervision over employees, would offer an alternative method of testing the progress of prevention work; but even these are as yet too meagre to afford a satis-

*Labor Statistics*, Industrial Commission of Wisconsin, November, 1924, Vol. II, No. II.

<sup>30</sup> See, for example, Mock, Harry E., M.D., *Industrial Medicine and Surgery*, pp. 79-89.

Rector, Frank L., "Physical Examinations in Industry," *Monthly Labor Review*, April, 1926, Vol. 22, pp. 766-771.

factory basis for comparison. In any case they would not take the place of comparative data on sickness prevalence.

## II. ALLEVIATION AND INSURANCE

In the absence of comprehensive data on the incidence of sickness and its duration, the lack of information on the extent and importance of wage losses sustained and of medical expenses entailed because of sickness is not surprising. Available data to show the need for alleviation are fragmentary and based upon the experience of relatively small groups. They rest largely upon the sickness records of benefit funds. In addition to this source of information, a few studies of wage losses due to sickness in small samples of population have been made, such as that for the Illinois Health Commission.<sup>31</sup>

Statistics of the extent to which sick benefits are available are meagre. No comprehensive survey has been made of workers' benefit funds since the publication, in 1908, of the Twenty-third Annual Report of the Commissioner of Labor on Workmen's Insurance and Benefit Funds in the United States. From all data available in 1913, Dr. Rubinow attempted an estimate of the number of workers covered by all kinds of sick benefit provisions.<sup>32</sup> Studies of the scope of union benefits have recently been undertaken by the American Federation of Labor.<sup>33</sup>

<sup>31</sup> Burgess, Ernest W., "A Study of Wage Earning Families in Chicago," Special Report I, *Report of the Health Insurance Commission of the State of Illinois*, May 1, 1919, pp. 302-303. See also, *Report of the Health Insurance Commission of Pennsylvania*, January, 1919, pp. 4-6, 87-138.

<sup>32</sup> Rubinow, I. M., *Social Insurance, with Special Reference to American Conditions*, pp. 281-298, especially pp. 292-293.

<sup>33</sup> See Perkins, George W., and Woll, Matthew, *Trade Union Benefits*, American Federation of Labor, 1925. The membership of the unions which give benefits may be estimated from figures of voting strength given in the reports of the conventions of the American Federation of Labor.

Statistics to test the adequacy of alleviation are mostly wanting. Apart from the fact, already suggested, that no comprehensive survey is available to show the scope of all forms of sickness benefits or even of each form, few data are at hand to show how adequate are the benefits afforded in individual cases—for example, to show what proportion benefits form of the total wage losses and medical expenses. A study made for the Illinois Health Commission gave information on this point for small samples of wage-earning families in Chicago.<sup>34</sup> Since in this country benefits are not usually measured in terms of wages but as "flat rates," which vary largely in amount from fund to fund, such data are necessary to appraise the adequacy of the available provisions for sick benefits.

Finally, relatively little material is available in regard to sickness as a cause of poverty, of dependency in old age, or of applications for relief or charity. Data on these points are to be found, for example, in the reports of special commissions appointed to study health insurance or old age dependency.<sup>35</sup>

Statistics for use in calculating costs of health benefits involve, in addition to the figures already discussed relative to the prevalence and duration of sickness and to the amount of benefits, data to indicate the effects of special limitations or provisions for drawing benefits, data on "moral hazard," and data on cost of administration. In appraising the available statistics on these points it should be remembered that rigorous exactness is not vital, since for practical purposes allowance for errors may be made by increasing the amount of

<sup>34</sup> Burgess, Ernest W., "A Study of Wage-Earning Families in Chicago," Special Report, pp. 304-305. See also, *Report of the Health Insurance Commission of Pennsylvania*, January, 1919, pp. 147-158.

<sup>35</sup> *Health, Health Insurance, Old Age Pensions, Report, Recommendations, Dissenting Opinions*, by the Ohio Health and Old Age Insurance Commission, February, 1919, p. 2. See also, *Report of the Massachusetts Commission on Old Age Pensions, Annuities, and Insurance*, January, 1910 (House Document No. 1400), pp. 39, 40, 55, 74.

“loading” in determining premium rates or cost of sickness benefits.

The effects of special limitations or provisions for drawing benefits can be ascertained only by analysis of the experience of funds which operate under special limitations or provisions in comparison with the experience of funds which operate without these conditions. Practically no data of this type are available.

Data on the elements and extent of “moral hazard” are extremely difficult to obtain. Even on such points as the number and proportion of cases of malingering, of fraudulent claims, or of delayed recovery, as well as on the purposeful production of sickness in order to draw sick benefits, practically no statistics are at present available in this country. Since these points represent problems of administration of sick benefit provisions rather than problems of sickness itself, statistics relating to them are chiefly significant in connection with administering existing sick benefit provisions or health insurance.

Data on costs of administration are likewise a by-product of the operation of sick benefit provisions. Analysis of the “loading” factor for health insurance premiums and data on the ratios between premiums collected and benefits paid throw light upon these administrative costs.<sup>36</sup>

Allowances made to cover all such special conditions applicable to particular groups may be checked by means of statistics based upon the actual experience of these groups. Data of this type on general costs are highly important to each fund or insurance company and each fund usually compiles such data for its own use. The experience of each fund covers, in a summary way, the combined result of all the factors in cost—moral hazard, special limitations and provisions for drawing benefits, and cost of administration—that affect the particular fund.

<sup>36</sup> See Rubinow, I. M., *Social Insurance, with Special Reference to American Conditions*, pp. 294-296.

The principal conclusion to be drawn from this review of the existing data on sickness among industrial workers and its alleviation is that the entire body of comprehensive statistics of health is yet to be constructed.

## CHAPTER IX

### A PROGRAM FOR HEALTH STATISTICS

The preceding chapters set forth a contrast between the statistical data needed to solve the problems connected with the protection of the workers' health and the alleviation of losses caused by sickness, and the actual data available. The present chapter is devoted to discussion of a practicable program by which existing statistics on these subjects can be supplemented, reorganized, and developed more nearly to meet the requirements.

Recommendations are limited to data which should be made available by governmental statistical agencies. The government has peculiar responsibility over questions of health, and only the government can dispose of sufficient resources to handle these questions adequately. This does not imply that private agencies have no responsibilities or that they should perform no functions in this program. Their responsibility for collecting and providing basic statistical materials is fundamental and cannot be shouldered by any other organizations. But in developing the statistical superstructure of compilation, tabulation, and analysis, governmental agencies can make the more important contribution. The responsibility of the government extends both to filling in gaps in the available data and also to collecting and tabulating all the statistical information required.

The program is divided into two parts, that relating to statistics needed for use in health protection and that relating to statistics needed for use in the alleviation of losses caused by sickness.

## I. HEALTH PROTECTION IN RELATION TO INDUSTRY AND OCCUPATION

*Comprehensive data on occupational mortality should be tabulated from the vital records of the population.* Statistics for showing comprehensively the relation between occupation and health (as shown in the death rate) are among the most immediately practicable lines of development. The basic records are already available in the vital statistics of the death registration area and in the census of occupations. To make these materials available for use requires, in the first place, the adoption of methods for eliminating, so far as possible, the sources of error, particularly in regard to occupations, in the original data. Statements as to occupation and industry should be entered in the same form on death certificates as on the records of the census enumerators. Special attention should be given to the possibilities of minimizing errors by means of the occupational classification of the data from the two sources. Secondly, to make the materials indicate significant relationships, the data must be tabulated comprehensively, that is, on a scale sufficiently great to insure a reasonable body of data when the analysis is carried to sex, age, particular occupations, and causes of death.

These tabulations should be restricted to the two or three years immediately before and after the date of the population and occupation census; and the period chosen for the mortality data, if possible, should be such that the date of the census will fall at its midpoint. The methods of analysis used in the English statistics of occupational mortality are sound and appropriate.<sup>1</sup>

In the analysis special attention should be given to the interpretation of results not only with due regard to the possibilities of error in the fundamental data, but also with regard

<sup>1</sup>See note 5, Chap. VII, p. 157.

to elements of selection, to the nature of occupations, and to the causes of death.

The comprehensive character of the data needed, the fact that both statistics of deaths and statistics of exposure are already obtained and analyzed by a Federal agency, and the extensive character of the research involved all suggest the desirability of analysis by a Federal rather than by a state agency.

*Statistics of the incidence of sickness in relation to industry and occupation should be extended along the lines already marked out.* In general, the development of adequate sickness records depends upon and follows the grant of sick benefits. But sick benefit systems already extend much farther than the development and utilization of their records. An adequate record system and statistical analysis should be built up to cover all grants of benefits. The development of this source of data offers great possibilities for significant statistics of sickness.

The need for a large mass of data, for careful selection and supervision of the original materials, and for analysis by sex, age, occupation, and causes suggests the need for a central statistical organization adequately equipped not only to assemble and analyze the existing sickness records but also to encourage the building up of a more comprehensive body of reports. All types of funds, so far as they can be persuaded to keep records in significant form, should furnish data to this organization. Establishment funds, workers' benefit associations, union funds, and other groups offering sickness benefits should contribute their record materials for analysis.

*Every effort should be made to obtain comprehensive data on specific occupational diseases.* Although in some states cases of such diseases are compensable, yet even in these their reporting is far from complete. Frequently the laws are extremely limited in their coverage. In states where occupational diseases are not compensable, data on their occurrence

are available only in general sickness and death statistics. The importance of many of these diseases is such as to justify special investigations into their prevalence. These investigations should supplement the statistical data that throw more general light upon the extent and importance of sickness among workers. They should aim to isolate and define the nature of the causes and causative conditions that render occupations hazardous to health. This type of research must, of course, be entrusted to agencies equipped with personnel and resources adequate and appropriate to the task. Only when such studies are made will remedial measures adequate to meet the problem be taken.

*Statistics of physical defects should be so expanded as to show the value of physical examinations in health protection work.* As statistics of morbidity are dependent, in general, upon the grant of sick benefits, these data are dependent upon the giving of physical examinations. Since the scope of the data is limited to establishments where the value of such examinations is recognized, emphasis upon the aspects of the statistics that show direct benefits to employers and employees is most needed. Data relating to the allocation of workers to work that will not be injurious, to health defects discovered and remedied, and to similar points that bear upon the usefulness of the material to individual establishments should also be developed.

*Statistical surveys of health hazards to be remedied should be made wherever they can be of immediate and direct use in health protection campaigns.* Whether these should be carried out by establishments, by state agencies, or by Federal or national agencies depends upon the immediate and practical use that can be made of the results. Agencies concerned with planning and carrying out measures of health protection should make surveys of health hazards whenever such surveys will aid in their work.

*Statistics of the scope of each important method of health*

*protection should be developed.* Such statistics constitute one of the most valuable series of data on the adequacy and progress of health protection. They should be compiled on a comprehensive scale to cover all establishments throughout the country. They should be supplemented, furthermore, by special studies of the value of each important method of health protection in order that industrial establishments and health protection agencies may be able to select measures that promise the best results.

## II. ALLEVIATION AND INSURANCE

Statistics of sick benefits, insurance, and insurance costs constitute a more or less natural by-product of efforts to meet the problems caused by loss of income through sickness. Their fabrication, therefore, is necessarily delayed until after the services which provide sick benefits are established. As a result, any program of statistics upon these subjects is intimately bound up with the program of extension of the services themselves. But in any case adequate statistical data are required in regard to the many types of services already provided.

Statistics of sick benefits and insurance should be developed along three principal lines.

1. *Comprehensive data should be assembled to show the scope of sickness benefits received by wage earners.* They should be classified by states and by types of plans. What proportion of workers, for example, are protected through health insurance, and what proportion through trade union or establishment sick benefit funds? These data are obviously required for any appraisal of the problem or its remedies.

With regard to the agencies to be used in collecting such data, they may be gathered and published appropriately either by Federal or by state services, so long as the grant of benefits remains in the field of private initiative. But if and when

states commence to administer plans of health insurance, the collection of statistics relating to the operation of their plans falls naturally within the province of the state bureaus charged with their administration.

2. *Data on the adequacy of existing plans to meet the needs should be developed.* They should cover not only the question of adequacy of scope, but also the relation between the amount of benefits furnished and the amount of losses. At present, statistics on these points can be gathered most easily by means of special investigations.

3. *Data should be developed to measure accurately the cost of various plans of sick benefits.* The data needed to determine premium rates or assessments are required by each agency which furnishes sick benefits and assesses the costs of this provision upon the group benefited. But for guidance in choosing the best methods and policies to alleviate the losses due to sickness among wage earners, data should be collected also on the expenses and overhead costs of each type of benefit fund. In connection with the selection of plans for health insurance, indeed, all available data on costs are of great value.

## CHAPTER X

### SUMMARY AND CONCLUSIONS

Two types of news items featured within the past year by the daily press epitomize the problems with which this book is concerned. Headlines have announced the occurrence in state after state of explosions in coal mines. During the period from January to September, 1926, twelve major disasters from the single cause, coal-dust and gas explosions, caused the loss of 271 lives. These catastrophes differ principally in the number of persons killed and injured and in details of the losses involved. The other type of news item reported deaths from acute lead poisoning of persons exposed to ethyl lead in processes of its manufacture. The publicity attending the latter resulted in recognition of the need for special precautions for the protection of workers employed in manufacturing or handling this substance, in research by public health authorities into the hazards to public health involved in the general use of ethyl gasoline, and in suspension of the manufacture and sale of gasoline containing this lead compound pending the results of this research. Though scientific investigation did not indicate that the fear of a public health hazard was well-founded, the publicity attending the deaths of workers in the industry appears to have accomplished useful results by securing protection for those engaged in the manufacture of ethyl lead. On the other hand, the loss of life in mine disasters still continues apparently unchecked.

To spectacular accidents or distressing diseases that strike down their industrial victims the attention of the public is

readily attracted. But public attention is less easily focused upon the need for planning and carrying through a program for preventing even these accidents and diseases. And in regard to less spectacular but constantly occurring, and in the long run much more numerous, types of accidents, illnesses and deaths, the public for the most part remains in ignorance of their importance. At the same time the man-in-the-street, the worker, the employer, and the public-spirited citizen would all agree that preventable accidents and sicknesses should be abolished. What, then, are the reasons why more has not been accomplished?

The outstanding fact that presents itself in answer to this question is that, in regard to both accidents and disease, the statistical ground-work essential for control is inadequate. Statistics are indispensable to any effective program of prevention. They are required at every stage. They stimulate action by showing how greatly it is needed; they show where the evils to be remedied exist, and hence where prevention is to be applied; they measure and test results. Though in the absence of intelligently planned measures of prevention statistics can only arouse public opinion and interest, their importance in an effective program of control is second only to the program itself of which they form an essential part. Hence, a first step toward progress in control of these problems is a study of the shortcomings of existing statistical data in relation to the requirements.

The requirements for statistics should be measured generously to accord with the importance of the results promised by an adequate program of control. Authorities estimate roughly that the annual economic losses from industrial accidents amount to something like 6.75 million dollars, and that from one-half to three-fourths of these accidents are preventable. The annual saving from preventable sickness and death over and above costs of prevention has been estimated at 1.5 billions of dollars. Even if the human welfare involved

were disregarded these possible economic savings would quite dwarf the sums required for developing the statistics necessary to carry out a comprehensive program of prevention.

The detailed requirements for statistics with regard to both accidents and disease are determined by the need for data to solve problems of prevention, of alleviating the consequences of unprevented accidents and disease, and of distributing costs through insurance.

To show the importance of prevention and alleviation, complete and significant data are required with regard to the prevalence of accidents and ill-health. Public attention is attracted by the spectacular, but if prevention is to apply to all accidents and disease and if the consequences of unprevented accidents and disease are to be alleviated, comprehensive data obtainable only by statistical methods must be available. But since these data on the prevalence of accidents and ill-health are essential in solving the problem of prevention, especially in showing where preventive measures are to be applied, they are discussed under the subject of prevention.

The requirements for statistics to aid in the prevention of accidents may be summarized under four headings: figures needed to locate and measure hazard, to analyze causes and contributory conditions, to evaluate methods and policies, and to test progress and results. The data required to locate and measure hazard include statistics of accidents for the principal industries and occupations classified by severity and related to exposure in such a way as to form frequency and severity rates. Data on the prevalence of hazardous conditions are also valuable whenever they can be used in campaigns for eliminating specific hazards. To analyze causes and contributory conditions data on accidents for each industry must be classified first by cause. To be of the greatest usefulness, the cause analysis must be specifically related to the particular hazards in each industry. In addition, studies should be made of the influence of contributory conditions, such as education, train-

ing, age, health, and other characteristics of the workers on the one hand, and lighting, ventilation, hours of labor, and working conditions on the other. To evaluate methods and policies, statistical data are required that will throw light upon critical issues. For example, a detailed analysis of statistics of causes may indicate the effectiveness of regulations requiring the wearing of goggles as a protection against eye injuries, or of inspections of boilers or of mines to prevent boiler or gas explosions. Statistics may be used to show the savings, financial and otherwise, that may be expected to result from introducing specific methods of prevention, such as the installation of rock-dusting apparatus to prevent coal dust explosions. Furthermore, the extent to which various methods and policies are actually used should be shown statistically. Finally, to test the progress and results of preventive work accident frequency and severity rates must be analyzed by industries and causes for each year in such a way as to permit comparison with statistics for preceding years. Such comparisons furnish evidence of progress or lack of progress in prevention.

A review of existing statistics in this field reveals serious deficiencies. The requirements are most nearly filled by the statistics of accident prevalence and causation collected by Federal agencies for the iron and steel industry, railroad transportation, and mining. In each of these industries annual statistics of accidents, covering all or the major part of the industry, are published. These statistics show frequency (and in the iron and steel industry severity) rates. In addition, detailed analyses of causes in relation to the particular hazards of each industry make the data of great value in prevention. But for other industries for which no Federal data are available the statistics collected by the states are disappointing. In many states statistics of accidents are neglected entirely. In the others there is no uniformity in the collection and tabulation of accident data; the scope of the reporting systems varies from state to state, the definitions differ, and

the tabulations lack comparability not only in scope but in the details of their cause and industry classifications. As a consequence the data for particular industries in different states cannot be combined with significant results. Furthermore, few states have made any attempt to collect comparable data on exposure, and hence frequency and severity rates cannot be calculated.

These defects in state statistics of accidents are due in large measure to the absence of a unified purpose in their collection and to the lack of centralized responsibility for their analysis. Except where they have broader jurisdiction, state compensation commissions are primarily concerned with compensation administration; hence the neglect in many states of accident statistics. Even when such data are tabulated the interest of each state is limited to that portion of each industry contained within its boundaries, and consequently the analysis of causes in relation to industry is likely to be carried, not to the point of greatest usefulness from the point of view of each industry, but merely to the point justified by the interest of each state in its own figures.

For alleviating the consequences of unprevented accidents the statistics required include the data needed to locate and measure losses, to test the adequacy of alleviation, to test the efficiency of administration of specific measures, and to throw light upon issues relating to the choice of methods and policies. To locate and measure losses there must be available not only a record of all accidents, but also complete data in regard to the medical expenses, wage losses, and losses in earning power sustained in each. Upon the adequacy of medical benefits light can be thrown by data showing the proportion of cases which failed to receive medical aid, the promptness of aid, the duration of the healing period with relation to each type of injury, and the proportion and results of infected cases. Upon the adequacy of compensation for wage losses light can be thrown by data showing the proportion of uncompensated

cases, the proportion of wage losses covered by compensation in compensated cases of different types and arising under different legal limitations, and the consequences of the total lack of compensation or of inadequate compensation. Light can be thrown upon the adequacy of provisions for rehabilitation training by data showing what proportion of the cases that would benefit by such training actually receive it, and how effective the training received is in restoring earning power. To test the efficiency of administration of specific measures complete statistical records of administrative acts, including data on costs of administration, are required, together with statistics to show the promptness with which claims are adjusted and payments made and the fidelity with which awards conform to the provisions of law. Finally, to throw light upon important issues relating to the choice of methods and policies, special studies are needed, for example, to show the relative merits of different types of compensation administration and the inadequacy of employers' liability as a method of compensating injuries in the few states and in those occupations and industries subject to Federal jurisdiction which still operate under this system.

Since states rather than industries have jurisdiction over and are responsible for measures designed to lighten the losses suffered in consequence of accidents, the statistics relating to alleviation must be appraised with reference to the needs of each state or jurisdiction. In general, states (and jurisdictions) which have no compensation laws lack data with respect both to the need for and the adequacy of alleviation. In states which have compensation laws the data are of all degrees of completeness, ranging from meagre statements of the number of claims and the amounts of awards to detailed tables analyzing amounts of awards and duration of medical care by type of injury and other factors. For all except a few states the general criticism can be made that the statistics are not oriented specifically to throw light upon the adequacy of com-

pensation or upon the efficiency with which the law is administered.

For distributing costs to industry through insurance the statistics required include the data necessary to form the basis for premium rates, that is, total (unit) costs of medical benefits and compensation for each type of accident discounted to the date of accident, frequency of accidents of each type by industries, and overhead costs. In addition, statistics are needed to show the extent to which various types of insurance are in effect, and the extent to which various methods, such as inspections, risk-rating, and furnishing of specific recommendations to employers, are used by insurance companies to prevent accidents. Data are also required upon the basis of which these methods can be evaluated.

With regard to statistics of insurance and its cost, many states publish data summarizing the operations of insurance companies under workmen's compensation and employers' liability laws. These throw light usually upon costs of administration or overhead costs. The state data on the occurrence of accidents by industries have already been described. In addition, private insurance companies have unpublished records, derived from their experience, which show the relation between payroll exposure and the occurrence of different types of accidents. Basic data relative to unit costs are limited to a few states and to insurance company experience; in lieu of more comprehensive materials the necessary estimates have to be based upon these data. Very little information on the scope or value of different methods of insurance is available.

Turning to the subject of the workers' health, two major purposes may be distinguished: protection of the workers' health, including prevention of disease; and alleviation for the consequences of sickness, principally through various forms of health benefits or insurance.

For health protection, six types of statistics are required.

- (1) To measure the prevalence of physical defects, data based

upon physical examinations of workers and analyzed by occupation and industry are needed. (2) To measure occupational morbidity, statistics of sickness should be available, based either upon records of absences from work due to sickness or upon records of sickness kept in connection with benefit funds or health insurance; and the number of cases of sickness should be related to the number of cases exposed to risk. These data should be analyzed not only by causes of sickness, but also by sex, age, industry, and occupation. Special statistics on the prevalence of specific occupational diseases, so-called, should be collected. (3) To show the responsibility of occupation over disease and death, further, statistics of occupational mortality are required. For sound conclusions the deaths in each occupation should be compared with the population at risk and analyzed by sex and age. (4) To show the prevalence of health hazards, statistics are needed on the extent to which materials or processes, for example, the spray-coating process, known to involve health hazards are used. (5) On the subject of methods and policies of health protection data are required, for example, to show the prevalence of health examinations in industry and of industrial clinics, the extent to which preventive treatment is made available to workers in industry, and the value of each such method of health protection. Finally, (6) to test the results and progress of prevention, comprehensive records of sickness and mortality, compiled in a uniform manner from year to year or over 10-year periods, are required; they should throw light upon changes in prevalence of defects, in incidence of sickness, and in the trend of occupational mortality rates.

With regard to existing statistics on health protection, the general verdict must be rendered that they are still in a fragmentary state. Beginnings have been made, in the form of special studies, in securing the data needed to show the prevalence of physical defects. Statistics of occupational morbidity are limited for the most part to comparatively small groups

of persons insured in establishment or workers' benefit funds. In but few cases are these analyzed by sex and age as well as by occupation. Apart from the occupational mortality statistics published in connection with the census of 1890, and from two or three special studies relating to specific occupations, the United States has no occupational mortality statistics. In certain states surveys have been made of the prevalence of health hazards within the state, either with respect to all industries or with respect to particular industries or types of hazards. A few surveys have been made of the extent to which methods of health protection have been adopted in industry; but these are far from comprehensive. Because of lack of information on the prevalence of defects, on the incidence of sickness, and on mortality by occupations, data to measure progress in health protection are, to a large extent, wanting.

For alleviating the losses due to disease and premature death the topics upon which statistics are required are similar to those described in connection with alleviating the losses due to accidents. To locate and measure losses the data required include, in addition to wage rates, the frequency and duration of sickness, the extent to which premature death occurs to wage earners, and the cost of medical attention of all kinds. The adequacy of measures of alleviation should be tested, first, by data showing the number and proportion of cases in which no benefits were received; and secondly, for cases where benefits were available, by data showing the adequacy of benefits in relation to medical expenses and wage losses. Tests of the efficiency of administration are afforded by statistics showing the length of time between the filing of claims for benefits and the receipt of awards, the extent of medical supervision over claims, the number and proportion of cases of malingering, and the number and proportion of fraudulent claims.

The determination of health insurance premiums calls for

statistics showing the incidence and duration of sickness in relation to benefits for each type of case and for statistics of administrative or overhead costs.

Special statistical studies are required also to throw light upon important issues. For example, the issue of state compulsory *versus* private voluntary insurance requires for its determination a statistical survey of existing voluntary provisions within the state in which the issue is raised, comparative data in regard to the adequacy of existing and proposed provisions, and data on the administrative and other costs of proposed plans of insurance and on the effect of each plan upon the "moral hazard,"—malingering, simulation of sickness, and prolongation of cures. Furthermore, to assist in working out methods of meeting the costs by assessments upon workers, employers, and the public, data are required on the costs which proposed plans would impose upon each interested party.

Statistics of alleviation and health insurance must be regarded as even less adequate than those relating to health protection. Only a few studies, limited to small areas, are available to show the extent of losses caused by sickness. Statistics of benefits consist, for the most part, of reports of funds concerning benefits given their own members. Comprehensive and up-to-date information on the scope of such funds is lacking. With respect to costs of administration of health insurance or sick benefits, statistics are limited to data which each fund requires for its own purposes.

It remains to summarize the conclusions to be drawn from this survey of the need for statistics relating to industrial safety and health in the form of a program of recommendations. To improve accident statistics the outstanding need is for the creation of Federal statistical services to collect the figures for each major industry and to analyze them by causes, in relation to exposure. The agency or agencies entrusted with the task should draw the data on accidents and exposure from individual establishments throughout the country, but where

state records of accidents are complete and where corresponding data on exposure are available, the data from these sources should, of course, be accepted. This method would encourage the industries themselves to furnish the necessary fundamental reports and would provide them, in return, with carefully analyzed statistics of the causes of accidents with especial reference to the conditions of hazard in each industry. Under this plan the collection, tabulation, and classification of all data relating to each industry would be in the hands of a single agency, which would insure its being carried out uniformly and in such a manner as to yield the most significant results.

The existing state statistics of accidents should be developed to provide the data needed by the various states to guide their legislative and administrative policies relating to accident prevention and alleviation. For example, are lives of workers in coal mines sufficiently protected by state legislation relating to inspection, rock-dusting, and similar safety devices and arrangements? Are injuries to workers in all industries adequately covered by measures of alleviation? In addition to the studies required to answer these questions of state policy, surveys of specific hazards should be made by establishments and industries as a basis for the development of programs for the elimination of these points of danger; surveys should be made of the extent to which methods of prevention are used; statistics of inspections should be reorganized to show whether such inspections are efficient in execution and comprehensive in scope; and finally, statistical researches into technical problems should be encouraged.

The statistics of alleviation should be reoriented and developed in such a way as to make them throw the fullest light upon the adequacy of alleviation for injuries. For states or jurisdictions operating under employers' liability legislation, new data are needed to expose the inadequacy of this type of law. The data already available should be reorganized where necessary to place benefits in relation to losses, and should be

supplemented by new studies to disclose the inadequacies or limitations of compensation laws. Special analyses should be made to throw light upon the adequacy of each form of alleviation, medical benefits, compensation for wage losses, and rehabilitation training. Statistics relating to the administration of compensation laws should be expanded so as to throw light upon its efficiency.

In the field of insurance for industrial accidents statistics should be developed to throw light upon the net costs of each type of accident and upon costs of administration. In addition, statistics should be collected to show the extent to which various methods of prevention are used by insurance companies or funds.

The program of additional statistics required for health protection includes six principal elements. The data on occupational mortality contained in the vital records of the population should be analyzed on a comprehensive scale. Statistics on the incidence of sickness in relation to industry and occupation should be extended in scope as rapidly as possible; where sick benefits are given the existing records should be developed to meet the requirements for statistical analysis; where no sick benefits are given, sickness records derived from establishment records of absences may be found useful. On cases of deaths from specific occupational diseases comprehensive data should be obtained which will show the adequacy of measures for their compensation. Statistics on the prevalence of physical defects should be expanded. Surveys of health hazards should be made where they can be used in campaigns for health protection. Finally, data bearing on the value of each method of health protection and on the extent to which it is used should be developed.

To aid in alleviation and insurance, comprehensive data should be collected to show the scope of existing sick benefits for wage earners. Data to show the adequacy of existing plans to meet the needs should also be developed, as well as sta-

tistics with which to measure the costs of administration of various plans for health insurance.

With these problems and purposes in view, it remains to call attention to three requirements for carrying into effect these recommendations. In the first place, adequate funds must be made available to carry forward the necessary statistical program. Appropriations must be made both by the Federal and by state governments for the use of the agencies entrusted with the work.

In the second place, the appropriations secured must be spent under competent direction. If success is to be attained in meeting technical problems the statistics should be gathered by persons trained both in general statistical administration and in the requirements of the particular field of work.

In the third place, the work should be organized on appropriate lines. The funds should be so allocated as to permit of supplementing existing statistics where this procedure will yield satisfactory results, of creating new agencies for statistical tabulation where necessary, and of developing new services by existing agencies where this method is the best.

In conclusion, the substantial results which can be accomplished in the control of problems of industrial safety and health—the saving of life, the diminution of injuries, the decrease in disease, the promotion of health, and the elimination of the economic and social consequences of accidents and sickness—constitute a plea for the appropriations necessary to collect the statistics required for control. The magnitude of the evils and the great possibilities for their control justify the collection of an adequate body of statistical data. In view of all the facts, why should not those governmental bodies, legislative and administrative, and those industrial organizations which are interested in promoting safety and health in industry proceed to formulate an adequate program and to collect the necessary statistics?



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